W7FG Vintage Manuals

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Manufacturer Drake

Model T-4XB

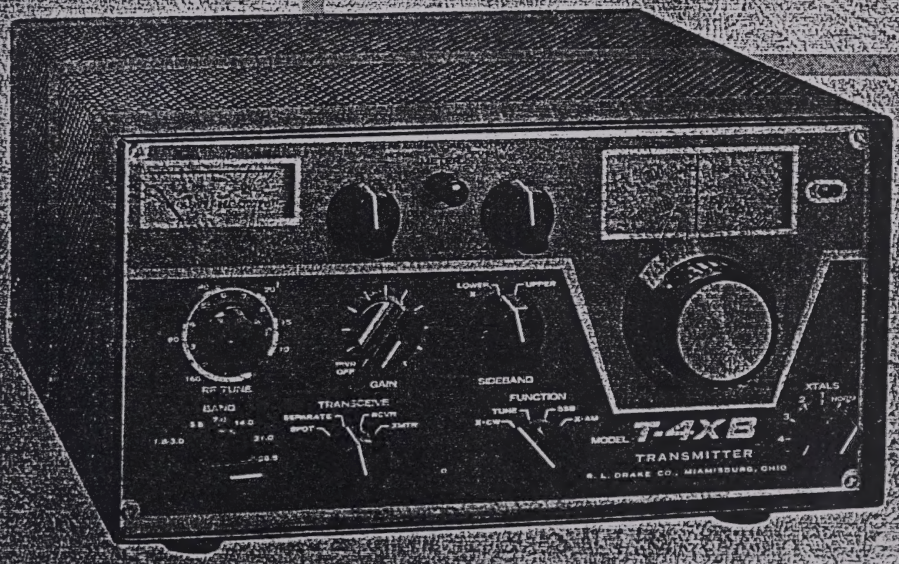
INSTRUCTION MANUAL

DRAKE

MODEL

T-4XB

TRANSMITTER



PRICE OF INSTRUCTION MANUAL $2.00

R. L. DRAKE COMPANY · MIAMISBURG, OHIO

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GENERAL SPECIFICATIONS

FREQUENCY COVERAGE: 3.5 - 4.0 MHz, 7.0 - 7.5 MHz, 14.0 - 14.5 MHz, 21.0 - 21.5 MHz, and 28.5 - 29.0 MHz with crystals supplied. Four accessory crystal sockets are provided for coverage of additional 500 KHz ranges between 1.8 and 30.0 MHz with the following exceptions: 2.3 - 3.0 MHz, 5.0 - 6.0 MHz, and 10.5 - 12.0 MHz.

DIAL CALIBRATION: Main dial calibrated 0 to 500 KHz and 500 to 1000 KHz in 25 KHz divisions. Vernier dial calibrated 0 to 25 KHz in 1 KHz divisions.

CALIBRATION ACCURACY: Better than 1 KHz when calibrated to nearest 100 KHz point.

STABILITY: Less than 100 cycles after warm up. Less than 100 cycles with 10% change in line voltage.

MODES OF OPERATION:

SSB:	Upper or lower sideband on all bands. VOX or push-to-talk.
CW:	Grid-block keying. VOX circuit is keyed for automatic transmit receive switching. Sidetone oscillator is keyed for monitoring. Shifted carrier system has no spurious output.
AM:	Controlled carrier AM modulation is built in. This system is compatible with SSB linear amplifiers. VOX or push-to-talk.
RTTY:	VFO easily adaptable to FSK. Signal frequency shifts same direction on all bands and same amount on all bands with a given dial setting.

SIDEBAND SUPPRESSION: 60 dB or better.

CARRIER SUPPRESSION: 60 dB or better.

AVERAGE DISTORTION PRODUCTS: In excess of 30 dB down.

FREQUENCY RESPONSE: Through the filter, 350 to 2700 Hertz at 6 dB down.

INPUT POWER: SSB and AM - 200 watts PEP, CW - 200 watts.

OUTPUT IMPEDANCE: Nominal 52 ohms adjustable with pi-network. (SWR should be 2:1 or less).

MICROPHONE INPUT: High impedance.

AGC: Operates on SSB to prevent flat topping due to overdrive.

CONTROLS AND JACKS:

Front

Main tuning, accessory crystal switch, Function switch, Sideband selector, Band switch, RF Tune, Gain, Plate tuning, plate loading, Transceive switch, plate current/relative output meter switch.

Side

Anti-Vox/Sidetone gain, Vox gain, and microphone jack.

Rear

Power connector, mute jack, receiver antenna jack, Anti-Vox/Sidetone jack, key jack, antenna connector, ground post, R-4, R-4A or R-4B injection jack, and Vox delay potentiometer.

Inside

Carrier balance control.

DIMENSIONS

5-1/2" high, 10-3/4" wide, cabinet depth 11-5/8", overall length 12-1/4". Weight of T-4XB - 14 lbs. 1 oz.

POWER REQUIREMENTS: AC-4 POWER SUPPLY

1. 650 volts at 200 ma average and 330 ma maximum with 10% regulation from 66 ma to 330 ma and maximum ripple of less than 1%.
2. 250 volts at 120 ma with 10% regulation from 82 ma to 120 ma. This includes the effect of the 650 volt supply change if both voltages are obtained from the same transformer. Maximum ripple must be less than 1/4%.
3. -45 to -65 VDC adjustable filtered bias into 33 K ohm load.
4. 12.6 volts AC or DC at 3 amps.

TUBES AND SEMICONDUCTOR COMPLEMENT

NUMBER	FUNCTION
MPF102	VFO
2N3858	VFO Buffer
2N3394	XTAL OSC.
1N714	Voltage Regulator
12BA6	IF Amplifier
12BY7	Driver
2 - 6JB6	Power Amplifier
12AX7	Mic. Amp/Sidetone Osc.
6EV7	VOX Amp.
6HS6	Premixer
6AU6	AM Modulator
12AX7	AGC Amp. Carrier Osc.
OA2	Voltage Regulator
3 - 1N483A	VOX & Anti-VOX Rectifiers
4 - 1N541	Balanced Modulator
1N483A	Trigger
1N270	Output Meter Detector
6AU6	Mixer
1N483A	Sidetone Keyer

I. DESCRIPTION

The R. L. DRAKE Model T-4XB Transmitter offers selectable single sideband, semi break-in CW, and controlled carrier AM transmission with capabilities for covering the 160 through 10 meters Amateur bands as well as many other non-ham band frequencies (MARS coverage, etc.).

The T-4XB is a complete transmitter which may be used for transceiving with the R-4, R-4A or R-4B Receiver or for independent receive/transmit usage. A front panel switch on the T-4XB selects between transceiving with the T-4XB VFO, the receiver VFO, or independent frequency control.

The T-4XB has CW sidetone oscillator, automatic transmit/receive switching on CW, transmitting AGC to prevent flat topping, plate meter/relative output indicator, two crystal lattice filters for sideband selection, receiver muting, receiver antenna switching, and VOX and PTT on AM and SSB, all built-in for the optimum in operating convenience and economy.

This unit provides 200 watts PEP input on AM and SSB and 200 watts input on CW for plenty of punch when run barefoot and more than ample drive for grounded grid linear amplifiers.

Compact size and continuity of styling combine for eye appeal and convenience.

II. INSTALLATION INSTRUCTIONS

A. UNPACKING

Carefully remove your T-4XB from its packing carton and examine it closely for signs of shipping damage. Should any be apparent, notify the delivering carrier immediately, stating the full extend of the damage.

Fill out and mail the enclosed registration card so that your warranty will be effective.

Save the packing material. You may need it later for reshipment or storage.

Inspect the packing material closely before putting it away to be sure you have not overlooked the accessory hardware packed with the unit.

B. LOCATION

In general, the location of the T-4XB is not critical. However, care should be taken to insure that space is provided around the unit to allow adequate air circulation. Extremely hot locations, such as near radiators or heating units, should be avoided. Do not cover the top of the unit with books, papers or pieces of equipment or overheating may result.

C. POWER REQUIREMENTS

The T-4XB should be used with our Model AC-4 Power Supply. This supply is designed to supply the proper voltages and currents for these units from 120/240 VAC 50/60 cycles and will fit inside the MS-4 Speaker, used with your R-4, R-4A, or R-4B. The T-4XB can also be operated from our Model DC-4 Power Supply which operates from 12 volts DC. The DC-4 also supplies 120 volts AC to power the receiver.

D. ANTENNA REQUIREMENTS

The T-4XB is designed for use with antennas resonant on the operating frequency and having approximate impedances of from 30 to 100 ohms. Although there are many types of antennas which will meet this requirement, the simplest is a one half (½) wave dipole, center fed with 52 ohm coax. For a detailed discussion on antennas,we suggest you refer to the ARRL Antenna Book or The Radio Amateur's Handbook.

Antenna connection to the T-4XB is provided at the SO-239 coax connector located on the rear of the shielded compartment housing the final amplifier components.

> CAUTION: NEVER ATTEMPT TO OPERATE THE T-4XB WITHOUT FIRST CONNECTING TO AN ANTENNA OR 52 OHM DUMMY LOAD OF SUFFICIENT POWER HANDLING CAPACITY OR SERIOUS DAMAGE CAN RESULT.

E. RECEIVER MUTING

The RCVR MUTE jack provides a short circuit to ground on receive and an open circuit on transmit. This jack can be connected directly to the Mute jack on the R-4, R-4A or R-4B Receiver with one of the hook up cables provided.

F. RECEIVER ANTENNA SWITCHING

The T-4XB contains built in receiver antenna switching. Simply connect one of the coax cables provided from the RCVR ANT jack on the rear of the T-4XB chassis to the receiver antenna terminals.

G. ANTI VOX & SIDETONE

The Anti Vox input and CW sidetone output utilizes the ANTI VOX/SIDETONE jack on the rear of the T-4XB chassis for connecting to the receiver and speaker. The impedance at this point is approximately 5000 ohms. To connect to the R-4, R-4A, or R-4B Receiver, simply couple the ANTI VOX/SIDETONE jack to the ANTI VOX jack on the rear of the receiver chassis with one of the cables provided. If the R-4, R-4A, or R-4B is not used, it will be necessary to use a 5000 ohm to 4 ohm audio output transformer between the ANTI VOX/SIDETONE jack and the speaker terminal of the receiver. The high impedance winding of the transformer should, of course, be connected to the ANTI VOX/SIDETONE jack and the low impedance winding should be connected to the receiver speaker terminals in parallel with the speaker. An alternate connection for this jack would be to the plate of the receiver audio output tube (a DC blocking capacitor is provided in the T-4XB).

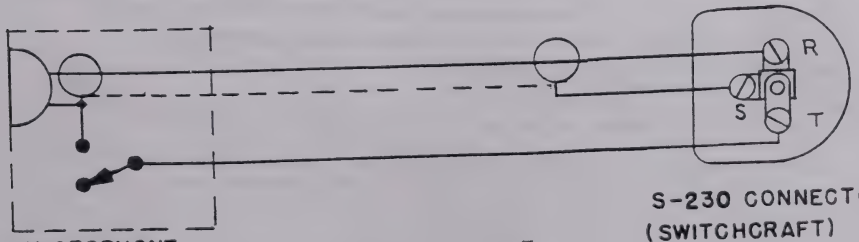
H. R-4 INJECTION

In order to transceive with the R-4, R-4A, or R-4B Receiver run a cable from the INJ. jack on the rear of the T-4XB chassis to the INJ. jack on the top of the R-4 or on the back of the R-4A or R-4B chassis. It will be necessary to remove the top cover of the R-4 to gain access to this jack. This cable will provide both RF and control voltage. (See Fig. #1)

I. MICROPHONE REQUIREMENTS

A microphone with a wide and flat frequency response will enable you to obtain peak performance from your T-4XB. For good VOX (voice control) operation, it is desirable for the mike to have a cardioid pattern to reduce pick-up from the back and sides. This enables you to operate with higher receiver audio gain, giving better VOX operation and reducing echoes, reverberation, and noise pickup. Microphones with limited low or high frequency response and with peaks in the voice range should be avoided.

A .210 inch diameter three conductor microphone plug (Switchcraft Type S-230) is provided with the T-4XB. The microphone must be connected as shown here for proper VOX and push-to-talk operation. Many microphones that are furnished with a switch are wired so that the microphone cartridge is open or short circuited unless the switch is depressed. This function must be defeated or VOX operation will be impossible.



J. GROUND REQUIREMENTS

The T-4XB should be attached to a good earth ground through as short and as heavy a piece of ground braid as possible for best results. A binding post is provided on the rear of the chassis for this purpose. (See Rear View, Page 13)

K. LINEAR AMPLIFIER CONNECTION

In order to use your T-4XB with a linear amplifier, connect as per Figure 2. Note that if the linear amplifier has negative going transmitting AGC voltage available, it can be connected to Pin 3 of the power connector to prevent the linear from flat topping.

For connections to the DRAKE L-4 or L-4B Linear Amplifier, see the L-4 or L-4B instruction manual.

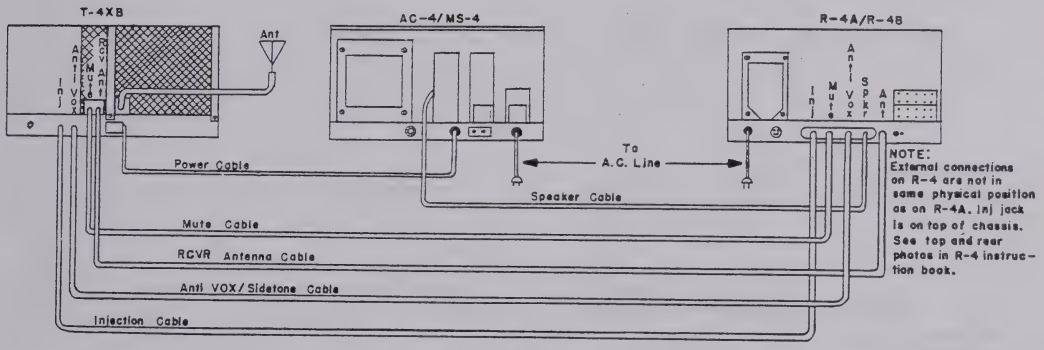


FIG. 1 CONNECTING THE T-4XB TO THE R-4B RECEIVER, AC-4 POWER SUPPLY, AND MS-4 SPEAKER

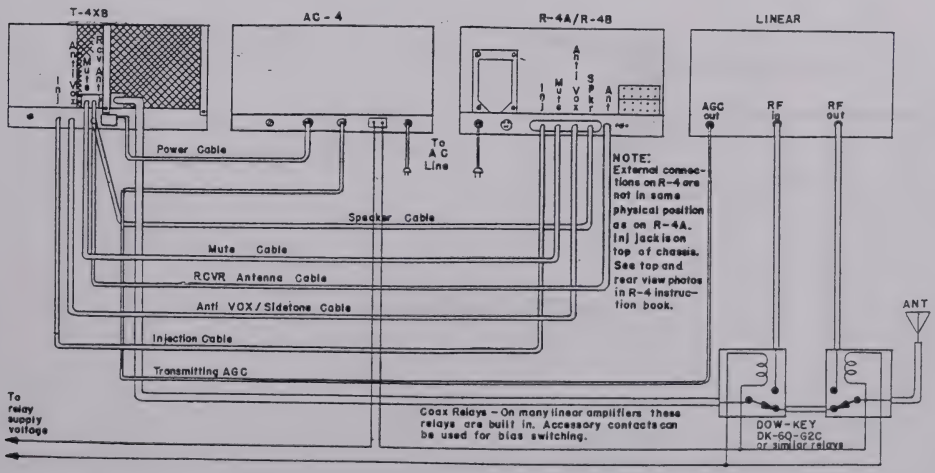


FIG. 2 CONNECTING THE T-4XB TO A LINEAR AMPLIFIER. FOR CONNECTIONS TO DRAKE L-4/L-4B, SEE L-4/L-4B INSTRUCTION MANUAL

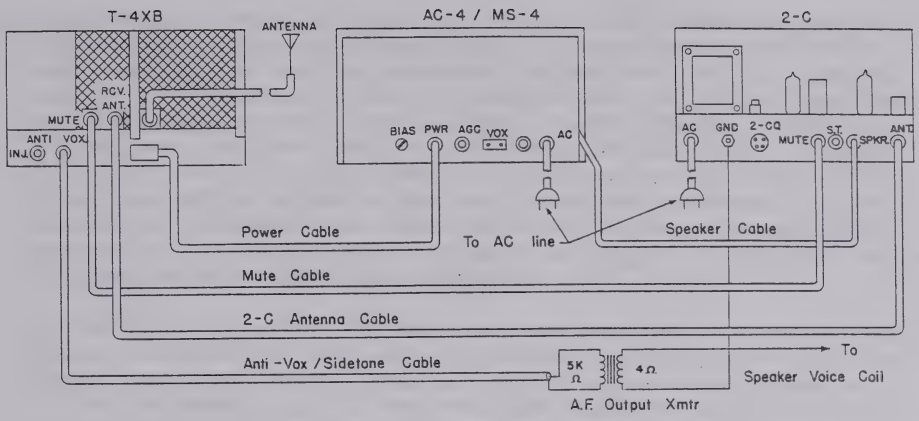


FIG. 3 CONNECTING THE T-4XB TO A RECEIVER OTHER THAN THE R-4/R-4A/R-4B

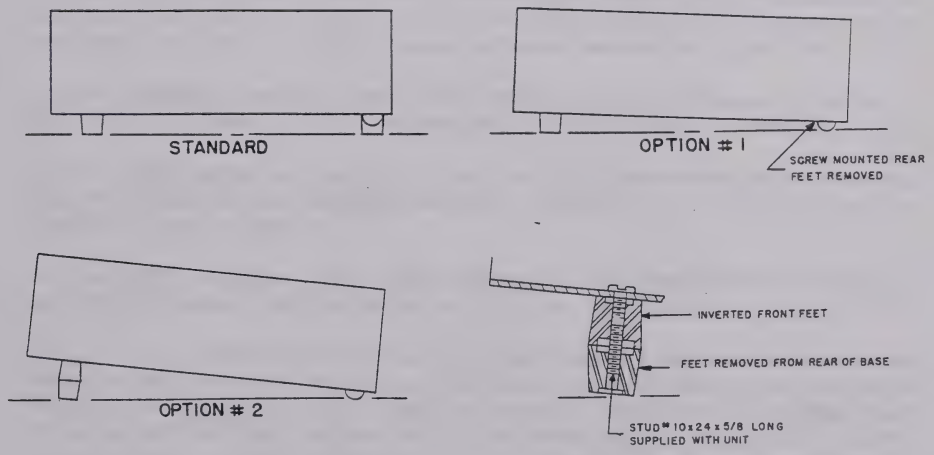

STANDARD
OPTION # 1
SCREW MOUNTED REAR FEET REMOVED
OPTION # 2
INVERTED FRONT FEET
FEET REMOVED FROM REAR OF BASE
STUD* 10x24 x 5/8 LONG SUPPLIED WITH UNIT

FIG. 4 VIEWING ANGLE OPTIONS

III. CONTROL FUNCTIONS

A. FRONT CONTROLS

1. MAIN TUNING - The MAIN TUNING knob on the T-4XB determines the frequency on which you are transmitting or transceiving. The vernier skirt around this knob is calibrated in KHz from 0 to 25. The main dial is calibrated in 25 KHz divisions and has two scales. Use the 0 to .500 scale for bands 7.000 - 7.500, 14.000 - 14.500, 21.000 - 21.500, etc.; use the .500 to 1.000 scale for bands 3.500 - 4.000, 28.500 - 29.000, etc. The small red knob just to the right of the dial scale is for adjusting the position of the indicator line for calibrating the main dial. The knob skirt is also adjustable by pushing it in slightly and rotating it in the desired direction while holding the MAIN TUNING knob stationary.

   To read your operating frequency on a ham band, add the reading in KHz on the dial skirt to the nearest number on the top scale left of red index line on main dial. Then add megahertz indicated on band switch. On the frequencies off the ham bands the megahertz to be added may be determined by subtracting 11.1 from the crystal in use.

2. TRANSCEIVE - The TRANSCEIVE switch determines the frequency controlling VFO when the T-4XB is used with the R-4, R-4A, or R-4B and is also used for frequency spotting.

   In the SPOT position, low level transmitter stages are switched on but the receiver is not muted to allow the transmitter to be tuned to the receiver frequency. This is done without putting a signal on the air.

   In the SEPARATE position the T-4XB determines the transmit frequency and the R-4, R-4A, or R-4B determines the receiving frequency.

   In the RCVR position, the R-4, R-4A, or R-4B determines both receiving and transmitting frequencies for transceiving. On this mode, the T-4XB VFO has no effect.

   In the XMTR position, the T-4XB determines the receiving and transmitting frequency and the receiver VFO has no effect.

3. XTALS - The XTALS switch is a five position switch used to determine which accessory band crystal socket will be inserted in the circuit. When in the NORM position, band and crystal selection is accomplished by means of the BAND switch (with the exception of the 1.8 - 3.0 setting). When the XTALS switch is set on one of the other positions, 1 through 4, the crystal inserted in the corresponding accessory crystal socket will be inserted in the circuit for that accessory band operation. The BAND switch must then be set in accordance with the information given on the crystal frequency chart for operation on the desired frequency.

B. FRONT CONTROLS & JACKS

1. PLATE - The PLATE control tunes the power amplifier Pi network circuit to resonance by varying the input capacity.

2. LOAD - The LOAD control matches the impedance of the power amplifier to the impedance of the load by varying the output capacity of the Pi network circuit.

3. METER - The METER reads plate current or relative RF output, depending upon the setting of the METER CONTROL.

4. METER CONTROL - The METER CONTROL is a combination spring loaded switch and potentiometer. The meter normally reads P.A. Plate current. When the knob is depressed, the switch converts the meter to read relative RF output and when rotated it varies the sensitivity of the relative output indicator. Releasing the control allows it to return to the plate current position.

5. RF TUNE - The RF TUNE control permeability tunes the driver grid and plate coils and the premixer output coils. The logging scale on this control is calibrated from 0 to 10 with markings showing the approximate settings for the 160 through 10 meter Amateur bands.

6. GAIN - This control regulates the microphone gain on AM and SSB. When the unit is on CW or TUNE, it is used to adjust the RF drive to the proper level.

   This control is connected so that it regulates VOX sensitivity as well as the audio drive to the balanced modulator. Since all changes in level due to the type mike, how close or loud you talk, etc., effect equally the VOX and the audio drive requirements, this eliminates the necessity of changing the VOX adjust control, located on the side of the chassis, once it is set properly.

   Since relay operation on CW depends partially on sidetone voltage fed through the VOX system, the GAIN control must be turned up slightly on CW to obtain positive relay action.

7. SIDEBAND - This control switches between either of two 2.4 KHz crystal filters for sideband selection. You will notice that lower sideband which is marked with an "X" must be used for CW and AM operation. The FUNCTION switch is also marked with an "X" in these positions.

8. BAND - The BAND control is a six position switch used to select the amateur band desired or to switch the RF circuits to the correct tuning accessory frequency ranges. The frequency range which may be tuned for each setting of the band switch control is given on the chart on Page 24.

9. FUNCTION - The FUNCTION switch is a four position switch which determines the mode of output.

WARNING: The TUNE position of this switch automatically places the transmitter on the air. Consideration should be given to other control settings as described under "TUNE UP PROCEDURE", to avoid damage to the final amplifier tubes, and to avoid unnecessary interference.

C. SIDE CONTROLS & JACKS

1. VOX - The VOX control is used to adjust the gain of the VOX amplifier and relay release time on CW.

2. ANTI VOX/SIDETONE - Adjusts the ANTI VOX sensitivity and sidetone output level.

3. MIC - The MIC jack consists of a .210 inch diameter phone jack of the three conductor variety to accommodate microphones with push-to-talk switches. A mating plug is provided with this equipment.

D. REAR CONNECTIONS & CONTROLS

1. ANT - Consists of SO-239 connector for attaching T-4XB to antenna.

2. RCVR ANT - Connects receiver to antenna through built-in antenna relay.

3. RCVR MUTE - Provides short circuit to ground on receive and open circuit on transmit for muting receiver.

4. ANTI VOX/SIDETONE - Serves as ANTI VOX input on receive and sidetone output on transmit.

5. INJ - Serves to couple the T-4XB to the frequency controlling circuits of the R-4, R-4A, or R-4B Receiver if transceive operation is to be used.

6. KEY JACK - This normally closed jack provides a means to connect a key for CW operation. On other modes the key bus is grounded so key can be left in key open position.

7. POWER CONNECTOR - A 12 conductor socket is provided for connection to the AC-3, AC-4 or DC-3, DC-4 Power Supply. A matching plug is provided on the power supply.

8. GROUND - A screw and nut are provided on the rear of the unit for attaching the ground lead.

9. VOX DELAY - A potentiometer is used to provide a variable time delay for VOX dropout.

E. INSIDE CONTROLS

1. CARRIER BALANCE - The CARRIER BALANCE control is located on top of the chassis, near right rear, and serves to balance the balanced modulator. This is a planetary drive potentiometer requiring 10 turns for complete travel.

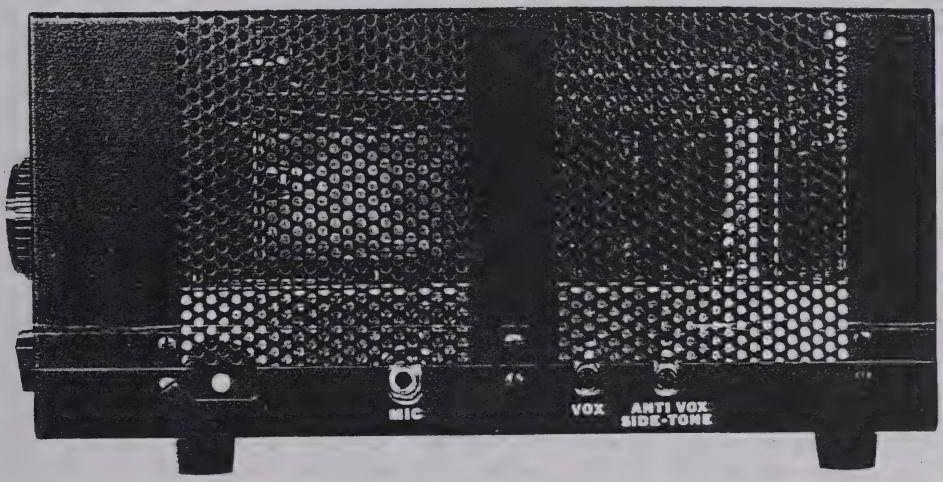


FIGURE 5 SIDE VIEW

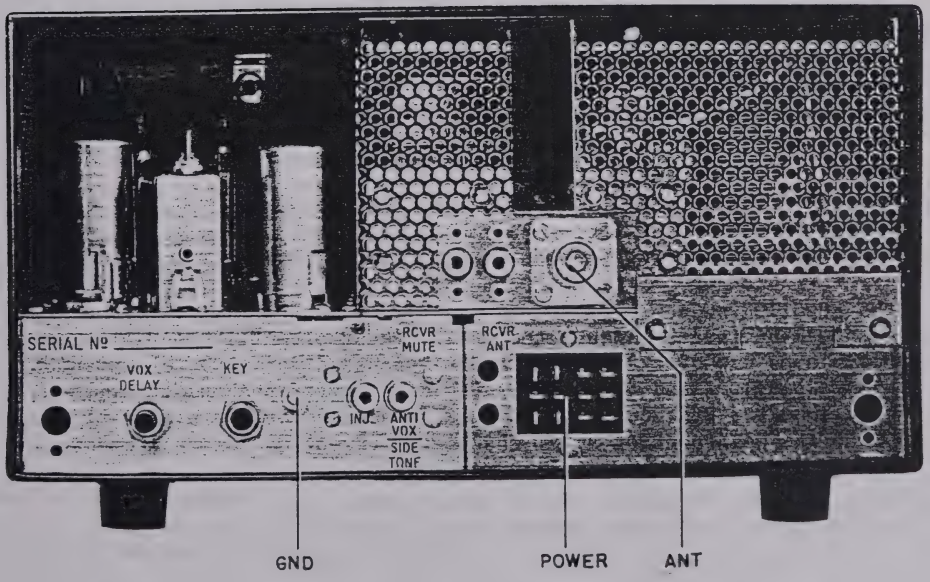


FIGURE 6 REAR VIEW

IV. TUNING PROCEDURE

> WARNING: UNDER NO CIRCUMSTANCES SHOULD OPERATION OF THE T-4XB BE ATTEMPTED UNLESS IT HAS BEEN CONNECTED TO A PROPER ANTENNA OR A DUMMY LOAD OF SUFFICIENT POWER HANDLING CAPACITY.

A. BIAS ADJUSTMENT

Before any type of operation is attempted, it will be necessary to set the power supply bias to the correct value. Proceed as follows:

1. Turn T-4XB on by rotating gain control clockwise until click is heard and set gain at minimum (extreme counter-clockwise position).
2. Set SIDEBAND switch on upper.
3. Set FUNCTION switch to tune.
4. Adjust AC-4 bias control for a reading of .07 on the plate amperes meter. This is 1½ marks below .1 on meter.
5. Return FUNCTION switch to SSB position. This completes bias adjustment.

B. TUNE UP ON DESIRED BAND

> WARNING: DO NOT ALLOW THE PLATE CURRENT TO EXCEED .07 AMPS FOR MORE THAN 5 or 6 SECONDS IF THE PLATE CONTROL IS NOT TUNED FOR PLATE CURRENT DIP OR MAXIMUM RF OUTPUT. Failure to observe this warning will result in rapid final amplifier tube deterioration due to excessive plate dissipation.

> Note: Incorrect setting of RF TUNE may cause illegal output from the transmitter on frequencies other than intended. Always preset the RF TUNE control before proceeding with other steps in tune up procedure.

Preset controls as follows:

1. BAND switch to desired band.
2. MAIN TUNING knob to a frequency inside the amateur band in use.
3. XTAL switch on normal.
4. GAIN fully counter-clockwise.
5. LOAD fully counter-clockwise.
6. SIDEBAND either upper or lower.
7. FUNCTION switch to SSB.
8. RF TUNE to center of band in use.

Rotate the FUNCTION switch to the TUNE position and advance the GAIN control approximately 1 division. Adjust the RF TUNE control until the plate current is about .15 amps and quickly tune the PLATE control for a plate current dip. (See above warning). Readjust the RF TUNE control for peak plate current, making sure that the PLATE control is still adjusted for plate current dip. Then advance the GAIN control until the plate current no longer increases.

Depress the OUTPUT METER control and rotate it for a significant indication on the meter. This control converts the plate amperes meter to a relative output indicator and varies its sensitivity.

Alternately adjust the LOAD and PLATE controls for maximum RF output. If the meter reads off scale, simply reduce its sensitivity by turning the OUTPUT METER control counter-clockwise.

When maximum output has been reached, release the OUTPUT METER control and re-adjust the PLATE control slightly to maintain plate current dip. At this point the meter should read between .25 and .32 amps. Keep the LOAD control peaked for maximum as read on the REL-OUTPUT METER. A setting that is not peaked could cause excessive plate dissipation and TVI.

The above tune up procedure should be completed as quickly as possible and the FUNCTION switch returned to the SSB position.

The transmitter is now ready to operate in any mode at the frequency to which it was tuned with the exception of the gain control setting which varies with the mode used.

C. CARRIER BALANCE ADJUSTMENT

The CARRIER BALANCE control is factory adjusted and should require a minimum of resetting under most conditions. The proper setting of this control can be checked using the following procedure:

After tuning up as described above, set the SIDEBAND switch on "X", Gain fully counter-clockwise, and FUNCTION switch to CW. Either close the push-to-talk line with a short or by plugging a microphone into the microphone jack and pressing the push-to-talk switch. Depress the REL-OUTPUT meter control and rotate it for maximum meter reading. Adjust the CARRIER BALANCE control and C-6 for zero meter reading. Return the FUNCTION switch to SSB. This completes the adjustment.

D. DIAL CALIBRATION

Due to the tolerance limits of the various crystals involved, dial calibration may vary slightly from band to band. For this reason, the MAIN TUNING dial index has been made adjustable by means of the small red knob to its right. To set the calibration on a given band, proceed as follows:

1. Set receiver to a known frequency within an amateur band such as 100 KHz calibrator point.
2. Tune MAIN TUNING dial of T-4XB to same approximate frequency.
3. Set TRANSCEIVE switch to SPOT and FUNCTION switch to SSB.
4. Carefully tune the T-4XB beat note toward zero beat until a "canary" type sound is heard. Two or three "tweets" per second indicate that the units are tuned to within two or three cycles of each other.
5. Slide red line to the right or left until dial reads correct frequency.
6. While holding main tuning knob stationary, push in on metal skirt and rotate it until it also reads correct frequency.

E. TRANSCEIVE ALIGNMENT

The carrier oscillator is set at the factory and unless you have good reason to believe it to be off, it would be best to assume it to be on frequency. The Carrier Oscillator can be checked for alignment as follows.

TRANSCEIVE ALIGNMENT (continued)

Set the controls as follows:

CONTROL or SWITCH	R-4, R-4A, or R-4B	T-4XB
BANDSWITCH	3.5	3.5
FUNCTION	Slow AVC	SSB
PASSBAND	4.8 with knob at 12 o'clock	------
AUDIO	1 o'clock	------
TRANSCEIVE	----------	SPOT
ANTI-VOX	----------	Full clockwise
SIDEBAND	----------	Set to the sideband that gives the loudest "canary" sound.
PRESELECTOR	Both R-4B, R-4A, R-4 and T-4XB Preselectors should be set to about 6.5 and both adjusted for the loudest "canary" sound from the speaker.	

Adjust C61 in the R-4, R-4A, or R-4B until the "canary" sound slows down to only a few chirps a second and then zero chirps a second and all that is heard is a single tone.

V. OPERATION

In the following discussion concerning operation on various modes, it is assumed that the T-4XB has already been tuned up on the desired band as described in the tuning procedure.

A. VOICE CONTROLLED & PUSH-TO-TALK OPERATION ON SSB

Preset controls as follows:

SIDEBAND----------Desired sideband (usually lower on 80 and 40 and upper on 20, 15, and 10)

FUNCTION SWITCH----------SSB

GAIN----------Fully counter-clockwise

VOX GAIN----------(Forward side control) fully clockwise

ANTI VOX----------(Rear side control) fully counter-clockwise

VOX DELAY----------(Right rear control) fully clockwise

The receiver should be operating normally on the same band except that the audio gain control must be turned all the way down.

Talk into the mike at normal voice level and increase the GAIN control until the plate meter kicks to about .15 amps. Reduce the VOX GAIN until a point is reached where the relay drops out too frequently to suit you. Then advance it just enough to prevent this. Increase the receiver audio gain control for normal volume and adjust the ANTI VOX clockwise just high enough to prevent cycling between transmit and receive. Adjust the VOX DELAY potentiometer for desired holding time.

For push-to-talk operation, be sure the switch on your microphone is properly connected as described under installation instructions. It may then be depressed at any time, thus overriding the VOX system. The transmitter will remain on and the receiver muted as long as the switch is down. If you do not desire the VOX to function at all, turn the VOX control fully counter-clockwise.

B. CW OPERATION

Set controls as follows:

SIDEBAND----------On "X" (lower)

FUNCTION SWITCH----------X-CW

GAIN----------12 o'clock

VOX GAIN----------Fully counter-clockwise

VOX DELAY----------Fully clockwise

To provide an audible tone when transceiving with a station on your transmitter frequency, the T-4XB output frequency in CW mode is shifted 1 KHz lower than what the controlling VFO indicates. Therefore, set the controlling VFO 1 KHz higher than the desired transmitting frequency.

Plug a key into the KEY jack on chassis rear and leave in key up condition. If an electronic keyer is used, connect it for grid block keying. If the sidetone is to be heard on transmit, the anti-vox circuit must be connected as outlined under installation instructions.

To transmit, close the key and advance the VOX GAIN control until the transmitter remains on transmit. Adjust the VOX DELAY control for desired "hold-in" time when the key is released.

Due to different operating conditions between TUNE and CW, the power output may be lower in the CW position for a given setting of the GAIN control. In CW, with the key down, advance the GAIN control clockwise just below the point at which the plate current no longer increases. Depress the REL-OUTPUT METER control, and adjust the LOAD control for maximum as read on the REL-OUTPUT METER.

Advance the ANTI-VOX/SIDETONE control on the side of the chassis until the sidetone reaches the desired volume.

The T-4XB uses automatic transmit-receive keying. This means that it will automatically transmit when the key is depressed and will remain in the transmit condition through keying at all normal speeds. The T-4XB will return to the receive condition when the key is released for a brief period. If the "hold-in" time is excessive, decrease the setting of the VOX DELAY control.

Manual transmit-receive switching can be accomplished by connecting an external switch (i.e. foot switch) from the push-to-talk terminal of the MIC jack to ground.

C. AM OPERATION

The T-4XB uses controlled carrier screen modulators for AM. This holds the unmodulated carrier input power to a few watts but allows up to 200 watts PEP input on voice peaks.

1. For AM operation set the FUNCTION switch to X-AM and the SIDEBAND switch to "X".

2. While talking into the mike at normal voice level, increase the GAIN control until the plate meter kicks to .15 amps on peaks. Care should be taken not to exceed this level as there is no AGC on AM.

If voice control is to be used the VOX and ANTI VOX controls should be adjusted as outlined under SSB operation. If push-to-talk is to be employed and you do not want the VOX to function at all, turn the VOX control fully counter-clockwise.

The T-4XB output frequency in AM mode is shifted 1 KHz lower than what the controlling VFO indicates. Therefore, set the controlling VFO 1 KHz higher than the desired transmitting frequency.

D. SPOTTING

The SPOT position of the TRANSCEIVE switch is used to bring the T-4XB to the same frequency as the receiver when separate control is being used. In this position, the receiver is operative but not connected to the antenna. The transmitter final is not operating but the frequency controlling stages are on and output will be heard in the receiver. On SSB set the receiver and the T-4XB to the same SIDEBAND. Bring the transmitter to the receiver frequency with the MAIN TUNING dial. A beat note will be heard in the receiver and its pitch will decrease as zero beat is approached. When the two units are near the same frequency, a chirping sound will be heard very much like the sound of a canary. When the "tweets" occur only a few times per second, the transmitter is within a very few cycles of the receiver frequency.

On CW set the receiver and the T-4XB for CW operation. A beat note will be heard as the receiver approaches the T-4XB frequency. Their frequencies will be the same when the pitch decreases to zero beat. It will be necessary to tune the receiver higher or lower than this frequency to hear an audio beat from your transmitter or another station on your frequency. On AM tune the T-4XB for maximum S-meter reading or set receiver on CW and zero beat.

E. TRANSCEIVING

When the T-4XB is used in conjunction with the R-4, R-4A or R-4B Receiver, transceive operation may be obtained.

> IMPORTANT: Only the R-4, R-4A or R-4B Receivers may be employed for transceiving. No earlier model DRAKE receiver or transceiver or accessory, or that of any other manufacturer will provide the correct injection frequencies.

When the T-4XB is used, three operating possibilities are available and are selectable by means of the TRANSCEIVE switch on the front panel, as follows:

1. When in the SEPARATE position, the R-4, R-4A, or R-4B determines only the receiving frequency and the T-4XB determines only the transmitting frequency.
2. When in the RCVR position, the R-4, R-4A, or R-4B determines both transmit and receive frequencies. In other words, you will transceive on the frequency to which the R-4, R-4A, or R-4B is tuned.
3. When in the XMTR position, the T-4XB determines the transceive frequency.

It is normal for the gain of the receiver and transmitter to vary some with the position of the transceive switch. In general, receiving with the XMTR position will be lower than RCVR or SEPARATE.

Due to the fact that the accessory crystal sockets are more numerous and more accessible on the R-4, R-4A, or R-4B, it would be desirable to use the receiver for transceiving on frequencies outside the amateur bands. If separate receiver transmitter operation is desired on such a frequency, two crystals will be required; one for the T-4XB and the other for the R-4, R-4A, or R-4B.

CAUTION: If transceiving outside the ham bands is to be attempted with the R-4, R-4A, or R-4B using the T-4XB, the chart on Page 24 should be followed closely when choosing crystals to avoid illegal spurious outputs.

When transceiving several precautions should be observed:

1. Be sure that the T-4XB is properly connected to the R-4, R-4A, or R-4B as illustrated in Figure #1.
2. Both receiver and transmitter must be switched to the same band.
3. Be particularly careful to stay within the confines of the amateur band to be used. This is an easy thing to forget on transceive since your transmitter will be operating on the frequency on which you are listening.
4. Note that band switches, sideband selectors, preselector, and RF Tune controls on both the receiver and transmitter must always be properly set whether transceive or separate receive and transmit functions are being used.

The choice of whether or not to transceive when the option is available is largely a matter of operator preference. When operating SSB, it has become standard practice for all stations in contact to be on exactly the same frequency. Transceive is very convenient under this condition. However, when working an elusive DX station which is operating outside the American phone band, separate control is mandatory. When operating in a round table in which one or more stations differ in frequency by a few hundred cycles, it is better to leave the transmitter set on the round table frequency and use separate control of the receiver to follow the strays.

On CW, if the note that your ear is trained to prefer differs from that employed by the T-4XB shifted carrier system, transceive may lead you to chase each other up or down the band as each retunes to get the pitch he likes. Separate control solves this problem.

F. OPERATION ON ACCESSORY FREQUENCIES

The design of the T-4XB Transmitter will permit operation of the unit on many frequencies outside the ham bands, such as MARS frequencies, etc. Some frequencies, where spurious outputs may occur or where sufficient output cannot be obtained, cannot be used. These frequencies are 2.3 to 3.0 MHz, 5.0 to 6.0 MHz and 10.5 to 12.0 MHz.

No crystal for 160 meter operation is included in the transmitter. If you plan to use this band, you need an additional crystal in one of the auxiliary crystal sockets. The same is true of the 10 meter band from 28.0 to 28.5 MHz or above 29.0 MHz.

To operate on these frequencies or on any of the frequencies shown in Figure #7 on Page 25 , a crystal of the frequency listed in this chart must be added either in one of the auxiliary sockets provided in the T-4XB or in the R-4, R-4A, or R-4B Receiver.

In the T-4XB, provision is made for plugging in up to 4 additional crystals and the XTAL switch on the front panel provides for selecting the desired crystal.

To tune up on such frequencies, set the XTAL switch to the crystal required, set the BAND switch as indicated in Figure #7 and the RF TUNE control as indicated in Figure #8.

If you plan to transceive, the preselector on the R-4, R-4A or R-4B must also be peaked on the correct frequency as indicated on the preselector chart in the instruction book for these receivers.

> CAUTION: It is possible to obtain output from the transmitter on the crystal frequency rather than the desired frequency if the RF TUNE control is misadjusted. The settings shown in Figure #8, page 26 should be checked and closely followed when tuning on any accessory frequency.

From this point on, tuning procedure should be the same as described for various modes of operation on the HAM BANDS.

> In selecting crystals for operation outside ham bands, Figure #7 should be followed carefully. Use of other crystals may result in illegal output on other frequencies as well as on the desired frequency.

G. CRYSTAL CONTROLLED OPERATION

The T-4XB is intended for VFO control only. However it may be modified so as to be crystal controlled for novice operation. Such a modification, when performed, will limit the unit to crystal control or transceive control with the R-4, R-4A or R-4B Receiver. A modification kit for this purpose is available complete with installation instructions, direct from the R. L. DRAKE COMPANY for $1.00 (U.S.Funds) postpaid within the United States.

Crystals for this application should be of the parallel resonant fundamental variety with HC-6/U holders. The modification kit for crystal controlling the T-4XB includes a trimmer capacitor across the crystal socket for fine frequency adjustment. It is possible to obtain crystal controlled transceive operation, using the R-4, R-4A or R-4B and T-4XB combination. The R-4, R-4A or R-4B Receiver has provisions for crystal controlling the received frequency. The injection fed to the T-4XB is also crystal controlled when operating in this mode.

1. Crystal controlled SSB operation: when crystal controlling the T-4XB directly by using a crystal in the crystal socket, the crystal frequency is equal to the desired output frequency plus 5645 KHz.

   If the crystal frequency calculates to a value above 15 MHz but less than 30 MHz, the second harmonic of the crystal is used, therefore, order a crystal of one-half the calculated frequency.

   If the crystal frequency calculates to a value above 30 MHz, the third harmonic of the crystal is used, therefore order a crystal of one-third the calculated frequency.

   Examples:

   Desired operating frequency = 7155 KHz
   Calculated crystal frequency = 7155 KHz + 5645 KHz = 12,800 KHz
   Order a 12,800 KHz crystal.

   Desired operating frequency = 21,145 KHz
   Calculated crystal frequency = 21,145 KHz + 5645 KHz = 26,790 KHz,
   26,790 ÷ 2 = 13,395 KHz
   Order a 13,395 KHz crystal.

   Desired operating frequency = 29,701 KHz
   Calculated crystal frequency = 29,701 KHz + 5645 KHz = 35,346 KHz
   35,346 KHz ÷ 3 = 11,782 KHz
   Order an 11,782 KHz crystal.

   NOTE: When operating crystal controlled with the T-4XB, the injection cable from the R-4, R-4A, or R-4B must be disconnected.

   The same crystal used for crystal controlling the T-4XB can be used in the R-4, R-4A, or R-4B to crystal control both the R-4, R-4A, or R-4B and the T-4XB.

2. Crystal controlled CW operation: to obtain CW operation with the T-4XB Transmitter , the 5645 KHz oscillator is shifted up in frequency about 1 KHz.

   Therefore to operate crystal controlled, either by crystal controlling the transmitter or R-4, R-4A, or R-4B Receiver, the crystal used must be 1 KHz higher in frequency than that used for SSB crystal controlled operation. In most cases such as novice operation, this is not important. But if exact frequency operation is wanted, this shift in frequency must be taken into account.

Examples:

Desired operating frequency = 7155 KHz
Calculated crystal frequency = 7155 KHz + 5645 KHz = 12,801 KHz
Order a 12,801 KHz crystal.

Desired operating frequency = 21,145 KHz
Calculated crystal frequency = 21,145 KHz + 5646 KHz = 26,791 KHz
26,791 KHz ÷ 2 = 13,395.5 KHz
Order a 13,395.5 KHz crystal.

Desired operating frequency = 29,701 KHz
Calculated crystal frequency = 29,701 KHz + 5646 KHz = 35,347 KHz
35,347 ÷ 3 = 11,782.3 KHz
Order a 11,782.3 KHz crystal.

Fine frequency adjustment can be made by the trimmer capacitor across the crystal socket.

All further tune up is exactly the same as described earlier under "Tune Up Procedure".

If used on the novice bands with crystal control, maximum legal input power is 75 watts which occurs when the plate meter reads .115 amps. To realize the most useful output under these conditions, readjustment of the BIAS control is suggested. Follow the Bias Adjustment procedure on Page 14 , but under Step 4, set bias for minimum readable plate current. If the transmitter is used both on novice band and by another operator on SSB or AM, the bias must be readjusted to its former value before such operation is attempted.

To load the transmitter for novice operation, preset controls as described under "Tune Up Procedure". Switch FUNCTION switch to TUNE and advance GAIN for a very slight increase in plate current. Tune RF TUNE for a peak in plate current, being careful not to exceed .115 amps, and quickly tune PLATE control

for a dip in plate current. Turn GAIN control fully clockwise and adjust LOAD control until plate dip occurs at .115 amps. If plate current dip is higher than this when LOAD control is set to 0, reduce the GAIN for plate reading of .115. Switch to X-CW and set GAIN control for a plate current of .115.

H. OPERATION WITH A LINEAR AMPLIFIER

The R. L. Drake Model L-4B Linear Amplifier was designed to match the T-4XB Transmitter in appearance and drive requirements to run the maximum legal input power. The L-4B offers continuous 2000 watts PEP SSB, and 1000 watts D.C. on CW, AM and RTTY operation covering the ham bands 80 through 10 meters. All frequencies 3.5 to 30 MHz may be covered with some retuning of the input coils.

The T-4XB Transmitter has sufficient output power to drive most linear amplifiers. A triode type grounded grid linear will usually present a satisfactory load (approximately 50 ohms) for the T-4XB.
If your linear is of the grounded cathode type with high input impedance, it will be necessary to install a resistive pad between the transmitter and the linear that will present the proper impedance. Such a pad must be made of non-inductive resistors and must have adequate power handling capacity to prevent its being destroyed when the transmitter is turned on.

Antenna switching should be accomplished as shown in Figure #2. Many linear amplifiers have these relays built in.

Before operating the T-4XB with a linear amplifier, the instruction manual of the linear should be consulted. The instructions contained here are of necessity generalized and precedence should be given to any specific precautions in the instructions accompanying the linear amplifier since it is improbable that these could lead to any danger to the exciter.

To load the transmitters into a linear, preset the controls as follows:

SIDEBAND----------Lower
GAIN----------Counter-clockwise
BAND SWITCH----------Desired band
RF TUNE----------Desired band
LOAD----------Zero

Turn FUNCTION switch to TUNE and advance GAIN control until plate meter moves up scale slightly from idling current. Peak RF TUNE, being careful not to exceed .150 amps plate current and tune PLATE control for dip in plate current. Set LOAD control as indicated in accompanying table. Redip PLATE control and tune linear as described in the linear amplifier instructions.

Now turn FUNCTION switch to desired mode of operation and advance GAIN control until desired amount of input to the linear amplifier is obtained.

Proper LOAD setting for 50 ohm resistive load

BAND	LOAD
160	2.5
80	3.5
40	4.5
20	4.5
15	4.5
10	4.5

FIGURE #7 CRYSTAL FREQUENCY CHART

CAUTION: USE OF THE T-4 or T-4XB ON FREQUENCIES NOT SHOWN IN THIS TABLE OR WITH CRYSTALS OTHER THAN THOSE SHOWN FOR A PARTICULAR FREQUENCY MAY RESULT IN ILLEGAL SPURIOUS OUTPUTS ON FREQUENCIES OTHER THAN INTENDED AND SHOULD BE AVOIDED.

USABLE FREQUENCY	DO NOT USE BETWEEN	CRYSTAL	OUTPUT FREQUENCY EQUALS DIAL PLUS	BAND SWITCH	RF TUNE
1.8 - 2.0	1.5 - 1.8	12.6	1.5	1.8 - 3.0	0.0 - 2.0
1.8 - 2.3		12.9	1.8	1.8 - 3.0	0.0 - 4.0
2.3 - 3.0	Do Not Use	None			
3.0 - 3.5		14.1	3.0	3.5	0.0 - 2.0
3.5 - 4.0		14.6*	3.5	3.5	2.0 - 4.0
4.0 - 4.35	4.35 - 4.45	15.1	4.0	3.5	3.5 - 4.5
4.3 - 4.6	4.6 - 4.7	15.4	4.3	3.5	4.0 - 5.0
4.5 - 4.7	4.7 - 4.8	15.6	4.5	3.5	4.5 - 5.0
4.7 - 4.8	4.6 - 4.7	15.4	4.3	3.5	5.0 - 5.5
4.8 - 5.0	4.7 - 4.8	15.6	4.5	3.5	5.0 - 5.5
5.0 - 6.0	Do Not Use	None			
6.0 - 6.5		17.1	6.0	7.0	3.9 - 4.5
6.5 - 7.0		17.6	6.5	7.0	4.0 - 5.0
7.0 - 7.5		18.1*	7.0	7.0	5.0 - 5.5
7.5 - 8.0		18.6	7.5	7.0	5.5 - 6.0
8.0 - 8.5		19.1	8.0	7.0	6.0 - 6.5
8.5 - 9.0		19.6	8.5	7.0	6.4 - 6.8
9.0 - 9.35	9.35 - 9.5	20.1	9.0	7.0	7.0
9.3 - 9.55	9.55 - 9.7	20.4	9.3	7.0	7.2
9.5 - 9.75	9.75 - 9.9	20.6	9.5	7.0	7.4
9.7 - 9.9	9.9 - 10.0	20.8	9.7	7.0	7.6
9.9 - 10.0	10.0 - 10.15	21.0	9.9	7.0	7.8
10.0 - 10.2	9.9 - 10.0	20.8	9.7	14.0	4.8 - 5.0
10.2 - 10.4	10.0 - 10.20	21.0	9.9	14.0	5.0 - 5.3
10.25- 10.5	10.1 - 10.25	21.1	10.0	14.0	5.0 - 5.3
10.5 - 12.0	Do Not Use	None			
12.0 - 12.5		23.1	12.0	14.0	6.6
12.5 - 13.0		23.6	12.5	14.0	6.7
13.0 - 13.5		24.1	13.0	14.0	6.8
13.5 - 14.0		24.6	13.5	14.0	7.0 - 7.2
14.0 - 14.5		25.1*	14.0	14.0	7.2 - 7.5
14.5 - 15.0		25.6	14.5	14.0	7.5 - 7.8
15.0 - 15.5		26.1	15.0	14.0	7.8 - 8.0
15.5 - 16.0		26.6	15.5	14.0	8.0
16.0 - 16.5		27.1	16.0	21.0	7 0
16.5 - 17.0		27.6	16.5	21.0	: 2
17.0 - 17.5		28.1	17.0	21.0	7.4
17.5 - 18.0		28.6	17.5	21.0	7.6
18.0 - 18.5		29.1	18.0	21.0	7.7
18.5 - 19.0		29.6	18.5	21.0	7.8
19.0 - 19.5		30.1	19.0	21.0	8.0
19.5 - 20.0		30.6	19.5	21.0	8.1
20.0 - 20.5		31.1	20.0	21.0	8.3
20.5 - 21.0		31.6	20.5	21.0	8.5
21.0 - 21.5		32.1*	21.0	21.0	8.6
21.5 - 22.0		32.6	21.5	21.0	8.8
22.0 - 22.5		33.1	22.0	21.0	9.0
22.5 - 23.0		33.6	22.5	21.0	9.0
23.0 - 23.5		34.1	23.0	28.5	8.0
23.5 - 24.0		34.6	23.5	28.5	8.2
24.0 - 24.5		35.1	24.0	28.5	8.4
24.5 - 25.0		35.6	24.5	28.5	8.5
25.0 - 25.5		36.1	25.0	28.5	8.5
25.5 - 26.0		36.6	25.5	28.5	8.6
26.0 - 26.5		37.1	26.0	28.5	8.8
26.5 - 27.0		37.6	26.5	28.5	9.0
27.0 - 27.5		38.1	27.0	28.5	9.2
27.5 - 28.0		38.6	27.5	28.5	9.2
28.0 - 28.5		39.1	28.0	28.5	9.4
28.5 - 29.0		39.6*	28.5	28.5	9.5
29.0 - 29.5		40.1	29.0	28.5	9.8
29.5 - 30.0		40.6	29.5	28.5	10.0

* Supplied with unit.

NOTE: Crystals can be obtained from the R. L. DRAKE COMPANY. When ordering please be sure to specify that the crystal you are ordering is for the T-4XB. R-4, R-4A, R-4B and T-4X, T-4XB crystals operate in the series mode and are interchangeable.

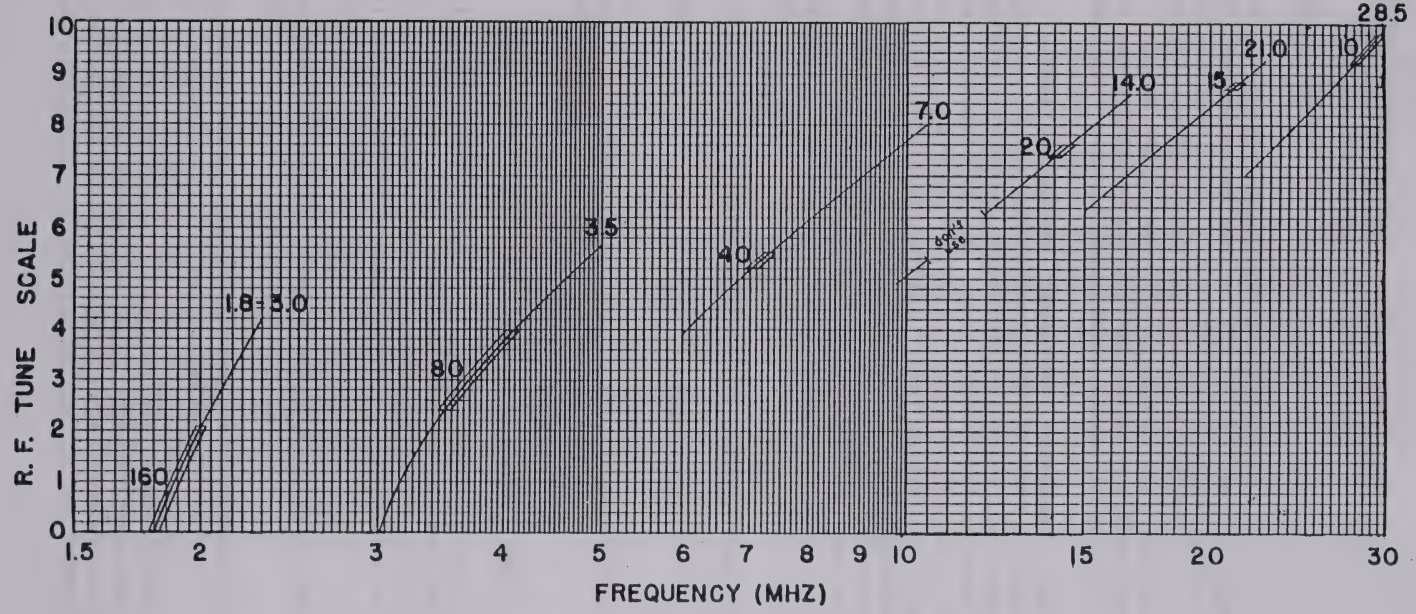


FIGURE 8

R.F. TUNE CALIBRATION CURVES of the useful range for each BAND switch position.

I. RTTY OPERATION WITH R-4, R-4A, or R-4B and T-4XB

1. GENERAL

In order to operate RTTY with the R-4, R-4A, or R-4B and the T-4XB, it is first necessary that an FSK circuit be installed in the receiver or the T-4XB, or both. If a circuit is installed only in the receiver, transceive operation with the receiver and the T-4XB can be obtained. If an additional FSK circuit is installed in the T-4XB, RTTY transceive operation can be obtained using either the receiver or T-4XB, and separate receiver/transmitter control is possible.

If only separate receiver/transmitter frequency control is desired, the installation of the appropriate shift circuit on the T-4XB is all that is necessary. However, if transceive operation is desired, the 5645 KHz oscillator circuit in the T-4XB must be modified to receive mark at 1275 and space at 2125 instead of the more commonly used values of 2125 and 2975 respectively. This requirement is based on the fact that the 5645 KHz oscillator of the T-4XB must be shifted by the amount of the mark audio frequency when the transmitter function switch is in the X-CW position to insure that you are receiving and transmitting on exactly the same frequency. This oscillator cannot be shifted 2125 cycles.

The above information is summarized in the following chart:

FUNCTION	FSK	5645 KHz Osc. Mod.
Separate control	T-4XB	None required
Transceive R-4, R-4A, or R-4B	R-4, R-4A, or R-4B	T-4XB
Transceive T-4XB	T-4XB	T-4XB

2. SHIFT CIRCUITS FOR THE R-4, R-4A, or R-4B and T-4XB

The following shift circuits are based upon the use of a terminal unit which provides to them a negative voltage on mark and a positive voltage on space. Such a circuit is described in detail by Irv. Hoff (K8DKC) in the May 1965 issue of QST. A similar circuit is shown here along with the shift circuits.

The resistors R_x should be of a value which will limit the current through the diodes to approximately 1 ma.

The capacitor values given are based on 850 cycle shift. If narrow shift is desired, smaller values will be required.

The shift circuit can be constructed on terminal strips and mounted under the nearest convenient screw. The FSK terminal on the VFO in the T-4XB or R-4/R-4A/R-4B is a small lug located between the prongs of the mounting clip on the right side of the VFO as viewed from the front.

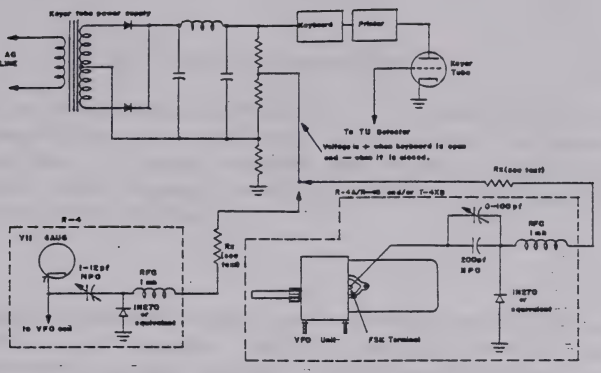


FIGURE 9 - FSK CIRCUITS

3. 5645 KHz OSCILLATOR

As stated previously, it is necessary to modify the 5645 KHz oscillator in the T-4XB if transceive operation or RTTY is contemplated.

To do this, remove the 10 PF capacitor C1 (see schematic diagram) and replace it with a ceramic trimmer having a value of about 5.5 to 18 PF (NPO). This trimmer should be carefully adjusted so that the frequency shift of the 5645 KHz oscillator is 1275 cycles when switching the function switch from SSB to CW.

4. TRANSMIT/RECEIVE CONTROL

Transmit/receive switching can be accomplished by inserting a plug in the key jack which connects to the send/receive switch on the printer in such a way as to be closed on transmit and open on receive.

5. OPERATION

To receive RTTY signals, the passband selector lever on the receiver should be on the 1.2 KHz position and the knob should be pointing to the dot corresponding to lower sideband. With the SSB/CW-AM switch in the fast AVC position, tune in on RTTY signal for correct indication on your terminal unit, and adjust the passband knob slightly for equal amplitude of mark and space.

Before transmitting is attempted, the variable capacitors in the shift circuits must be adjusted for the correct value of shift.

Having accomplished this, tune up the transmitter in the presceibed manner. If a send/receive switch is connected across the key jack as described above, it must be closed. Adjust the plate and load controls as described under "Tuning Procedure". It is very important that the LOAD control is not advanced further clockwise than is necessary to obtain maximum RF output into the load.

To operate, set the function switch to X-CW and the sideband switch to X (lower). Transmit/receive switching can be accomplished by opening and closing the key or a switch connected across the key.

VI. THEORY OF OPERATION

The signal which is transmitted by your T-4XB is the result of mixing three separate oscillators and the audio signals from the mike as well as in the case of AM or SSB. In going through the theory of operation, we will use a SSB signal as the basic example and then point out the difference employed in generating an AM or CW signal.

The signal on single sideband begins in a crystal controlled oscillator V-1A running at 5645 KHz on all bands. Output from this tube is fed to a four diode balanced modulator through the carrier balance control R-4.

The audio signal from the mike is amplified by V-9. Note that half of the GAIN control R-84 appears in the grid circuit of the second half of this tube and serves to control its output.

Two different audio outputs are taken from V-9B. Low impedance output from the cathode is applied to the balanced modulator through the FUNCTION switch for SSB operation. High impedance output is taken from the plate and goes to the grid of V-11 for screen modulation of AM. It is also fed to the VOX amplifier V-10A through the VOX Adjust control R-89. The output from V-10A is rectified and thus supplies positive DC voltage which is applied to the grid of the relay control tube V-10B, causing it to conduct and close the transmit relay. Audio voltage from your receiver reaches the transmitter through the anti-vox cable and is rectified by D-9 and D-12. The resulting negative voltage is applied to the grid of V-10B, so that audio from the speaker picked up by the mike will not cause the relay to close.

For push-to-talk operation, the negative bias on V-10B is shorted to ground, thus causing the tube to conduct and close the relay and hold it in as long as the push-to-talk switch is closed.

Returning to the balanced modulator, the audio and 5645 KHz RF inputs combine to produce an output of double sideband suppressed carrier. This is amplified through V-2 and, after impedance transformation in T-2, is applied to either the upper or lower crystal filter where the undesired sideband is filtered out. The resulting SSB signal is fed through T-3 to the mixer stage V-3.

The second input for this mixer is supplied by the premixer stage.

In the T-4XB the permeability tuned VFO (Q-2), controlled by the main tuning dial, oscillates on frequencies from 4955 to 5455 KHz. Output from this stage goes to the premixer through buffer stage Q-1.

Another transistor oscillator (Q-3) is crystal controlled and runs at frequencies 11.1 MHz above the low edge of the band in use.

In the premixer stage V-8, the output of the high frequency crystal oscillator and the VFO are combined and the difference is taken from the plate through T-4 and T-5 and fed to the mixer V-3.

Note that when the T-4XB is being used to transceive, the receiver may also be used as the frequency control with the injection voltage being supplied from the receiver Or, if desired, the T-4XB may supply the injection voltage through the same cable to control the receiver.

Returning to the mixer, V-3, we have a 5645 KHz SSB signal being supplied to the control grid from the filter, and high frequency injection from T-5 to the same grid. The plate of this tube is tuned to the difference of these two signals by T-6. It then goes to the driver stage V-4 where it is amplified and applied to the parallel grids of the 6JB6's, V-5 and V-6 through the tuned circuit of T-7.

These tubes serve as linear amplifiers and raise the signal to a suitable power level for transmission. The output is matched to a 52 ohm load by means of the Pi-network consisting of C-62, L-9, L-10, and C-70.

The two injection frequency transformers, T-4 and T-5, and the two driver transformers T-6 and T-7 are all permeability tuned by the RF TUNE control which positions their slugs in such a manner that the correct relationship between injection and output frequency is maintained. The injection frequency is always 5645 KHz higher than the transmitted frequency.

In order to minimize flat topping in the final stage if too much signal is provided by the driver, a transmitting AGC circuit is included. At the first trace of over-drive, grid current will be drawn which produces a voltage drop across R-29. The small negative going voltage thus obtained is applied to the cathode of V-1b where it is amplified. It is then applied to the grid of V-2, thus reducing the driving signal.

The meter of the T-4XB normally reads final amplifier plate current. It is connected in the cathode lead of these tubes.

When the METER control on the front panel is depressed, the meter is connected as an RF output meter through R-37 and D-5. This circuit samples the output voltage at the antenna and rectifies it. R-37 is made variable to control the sensitivity of this circuit in order that it may be used both with full power output and with very little power output when checking carrier balance.

In the CW mode, the 5645 KHz oscillator is shifted slightly in order to put the carrier within the passband of the "lower" crystal filter. A DC voltage is applied to the balanced modulator, thus unbalancing it. The amount of DC voltage and thus the amount of RF output is determined by the setting of the GAIN control. The signal then proceeds through the unit as it does on SSB.

Grid block keying of the mixer V-3 and driver V-4 is used. The sidetone oscillator utilizes the first audio stage V-9 as a phase shift oscillator to produce an audio signal for monitoring. When the key is down, this signal is fed to the receiver audio output transformer through the anti-vox cable using V-9b and V-11 as amplifiers. When the key is up D-8 shorts this signal to ground due to the fact that keying is also applied to it.

To trip the transmit/receive relay instantly when the key is closed, a pulse generated by D-7 and C-~~134~~ 131 is applied to the grid of the relay control tube V-10. During keying the relay will remain in the transmit position since keyed sidetone output is applied to the VOX system.

On AM the carrier oscillator V-1 is again shifted into the passband of the lower sideband filter. A DC voltage applied through R-76 is used to unbalance the balanced modulator.

Audio from the mike amplifier is supplied to V-11 which provides modulation to the screen of the driver stage V-4. The resulting output signal is controlled carrier screen modulated AM. Note that the AGC circuitry does not function when the transmitter is on AM.

VOX and push-to-talk functions are identical on AM with those described for SSB.

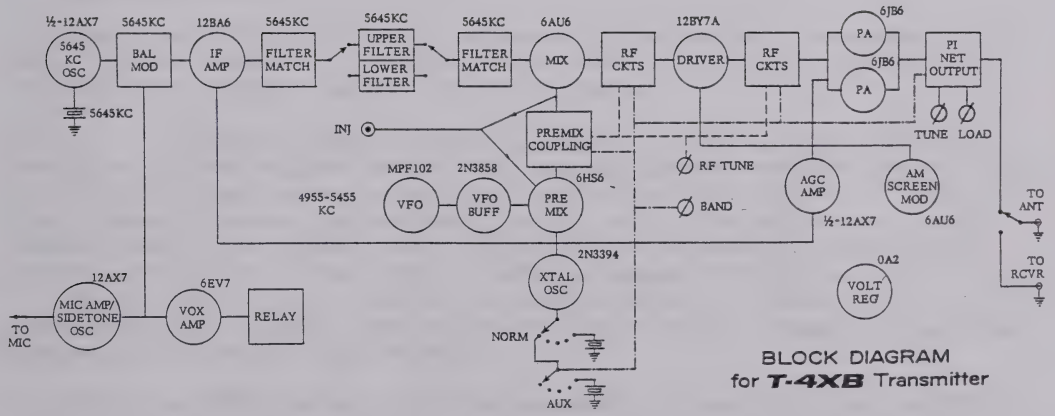


FIGURE 10

VII. SERVICE DATA

If you have technical questions or wish factory service on your transmitter, write to the R. L. DRAKE COMPANY, CUSTOMER SERVICE DEPARTMENT. We will completely align your transmitter for $10.00 (U.S. Funds) if it has not been tampered with or modified. Transportation charges are extra. Other repairs will be made on a time and material basis. Before returning equipment, please write first for authorization.

A. REMOVING TOP COVER

WARNING: Extreme caution should be taken when the top and bottom covers of the T-4XB are removed. High voltage is present at several points which could cause a lethal electrical shock!

1. Remove the 3 top screws on each side of the T-4XB.
2. Remove cover by first pulling up on the rear and then on the front of the cabinet.

B. REMOVING BOTTOM COVER

1. Remove the 6 bottom screws from the sides of the T-4XB.
2. Lift the T-4XB chassis out of bottom cover.

C. TUBE REPLACEMENT

In general, most trouble in radio equipment of good design is due to tube failure. The best method of finding defective tubes is by direct substitution. It is best not to rely too heavily on tube checkers.

The T-4XB has been designed so that, with the exception of V-5 and V-6, tubes can be replaced without need for realignment. When V-5 and V-6 are replaced, the final amplifier section should always be neutralized. See Section C under alignment instructions. If V-5 and V-6 are replaced with a different brand than originally supplied, it will be necessary to realign the driver plate circuit. See Section A under alignment instructions. The T-4XB is shipped with matched pairs of 6JB6A tubes. Matched pairs of 6JB6A tubes are available from the factory for $6.00 (U.S. Funds) per set plus postage at the time of this printing.

To replace the 6JB6A tubes, it will be necessary to remove only the top of the final amplifier cage. This can be accomplished by removing the forward and rear sheet metal screw holding the top to the cage and then lifting the top out of the two side clips. To replace the cage simply reverse the process. Be sure that the parasitic suppressors do not short to the cage.

D. TROUBLE-SHOOTING

Careful consideration has been given in the design of the T-4XB so to keep the maintenance problems to a minimum. However, it is quite possible that some problem will arise which cannot be cured by tube substitution. If this occurs, we suggest that you either return your unit to your dealer, or write

direct to our CUSTOMER SERVICE DEPARTMENT describing your problem in detail. Include full information concerning external connections, control settings, tubes substituted, etc. Do not return equipment to the factory without prior authorization. Always disclose your serial number when requesting service information.

In case of malfunction, first check power supply fuse and filament fuse in the T-4XB for continuity. The voltage and resistance charts which follow should be valuable in isolating minor problems. However, no attempt should be made to service the T-4XB unless you are thoroughly familiar with electronic circuitry and servicing technique. CARE SHOULD BE TAKEN NOT TO DISTURB THE LEAD DRESS IN THE T-4XB SINCE SEVERAL CIRCUITS ARE QUITE CRITICAL IN THIS REGARD.

Figure #11 RESISTANCE CHART

NUMBER	TYPE	1	2	3	4	5	6	7	8	9
V-1	12AX7A	15 K	220 K	3.3 K	Fil	0	0	10 K	28 K	NC
V-2	12BA6	1 meg	0	0	Fil	15 K	30 K	47 K		
V-3	6AU6A	330 K	0	Fil	Fil	14 K	14 K	50 K		
V-4	12BY7A	150	68 K	0	Fil	0	NC	14 K	45 K	0
V-5	6JB6A	14 K	33 K	54 K	0	Fil	33 K	16 K	0	54 K
V-6	6JB6A	14 K	33 K	54 K	Fil	Fil	33 K	16 K	0	54 K
V-7	0A2	11 K	NC	NC	NC	NC	NC	9*		
V-8	6HS6	330 K	0	0	Fil	14 K	90 K	470		
V-9	12AX7A	360 K	3.3 meg	0	Fil	Fil	280 K	500 K	3.3 K	0
V-10	6EV7	100 K	500 K	820	Fil	Fil	18 K	1 meg	0	0
V-11	6AU6A	22 meg	0	Fil	0	47 K	30 K	0		

NOTES:

1. All measurements were made from ground with transmitter connected to AC-4 Power Supply and with power supply disconnected from AC line.
2. Controls were set as follows: BAND - 7.0; FUNCTION - TUNE; GAIN, VOX, and ANTI-VOX controls all fully clockwise. The position of other controls is unimportant.
3. * This resistance will vary widely on various ohmmeter ranges due to the characteristics of diode D-9.

Figure #12 VOLTAGE CHART

NUMBER	TYPE	1	2	3	4	5	6	7	8	9
V-1	12AX7A	150	1.6	4.2	12.6*	0	0	-62	-62	
V-2	12BA6	0	0	0	12.6*	250	60	2.8		
V-3	6AU6A	0	0	6.3*	12.6*	240	142	2.35		
V-4	12BY7A	3.5	0	0	12.6*	0	NC	250	185	0
V-5	6JB6A	250	-62	.9	0	6.3*	-62	250	0	.3
V-6	6JB6A	250	-62	.9	6.3*	12.6*	-62	250	0	.3
V-7	0A2	150	NC	NC	NC	NC	NC	.5		
V-8	6HS6	.7	0	0	6.3*	250	130	3		
V-9	12AX7A	140	-.9	0	6.3*	6.3*	150	0	1.4	0
V-10	6EV7	100	0	1.3	6.3*	12.6*	200	-.8	0	0
V-11	6AU6A	-1.0	0	6.3*	0	25	110	0		

NOTES:

1. All measurements were made from ground with an 11 megohm VTVM (Vacuum Tube Volt Meter).
2. Unit was tuned into dummy load on 40 meters as described in "TUNING PROCEDURE", GAIN control was reduced to minimum, and FUNCTION switch is left on TUNE.
3. AC-4 Power Supply was used.
4. An * indicates AC voltage.

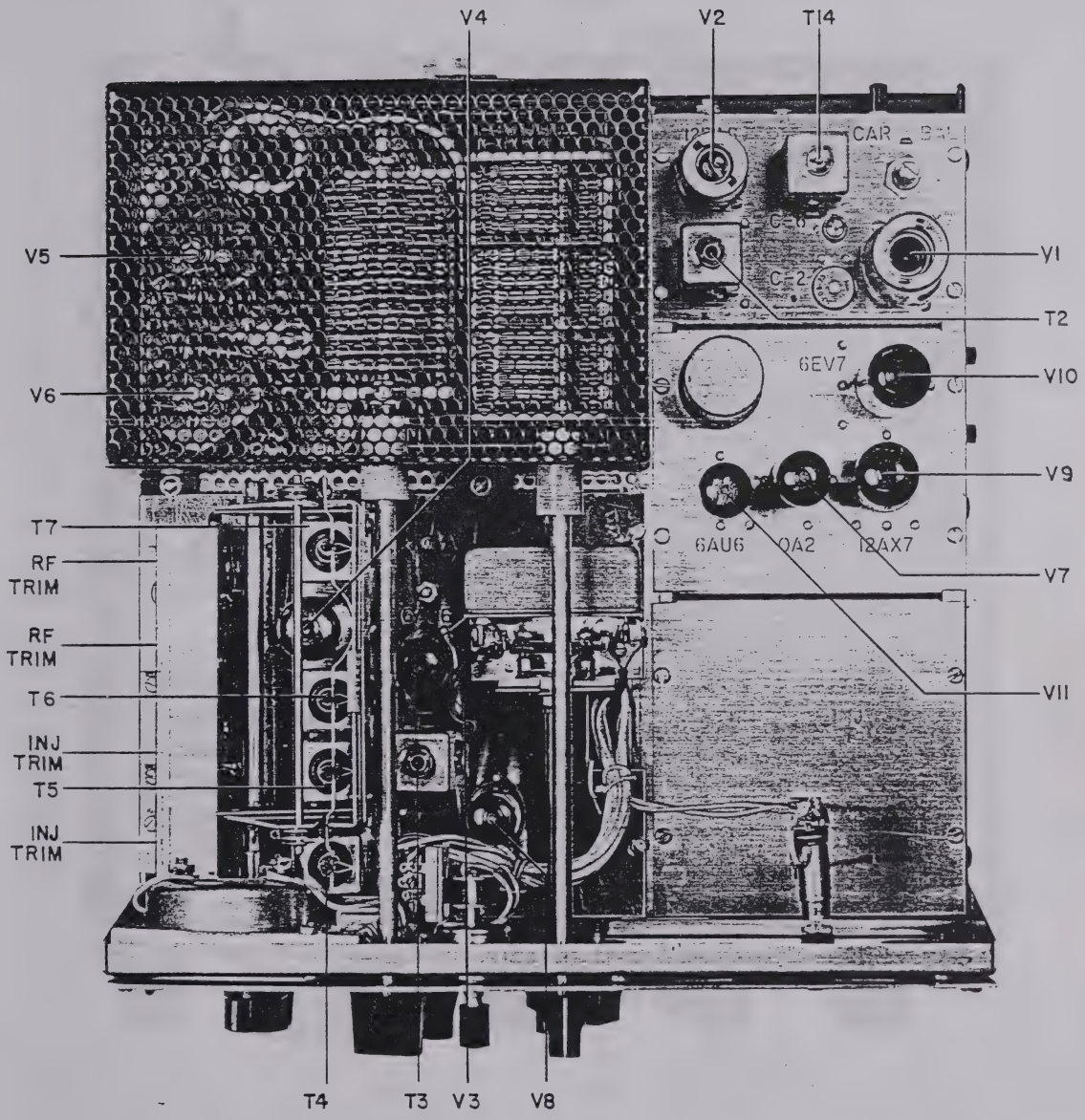


FIGURE 13 TOP VIEW T-4XB

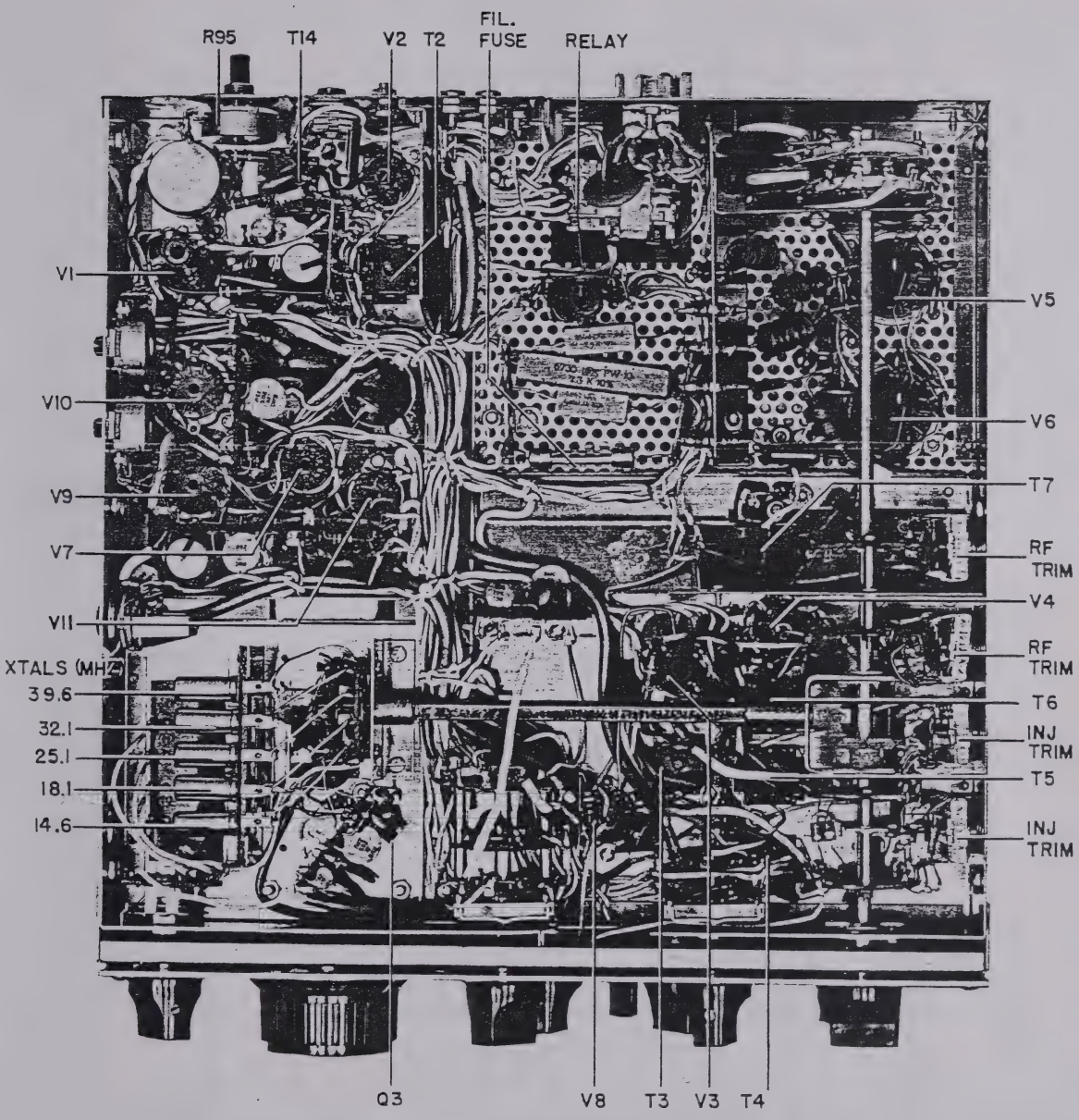
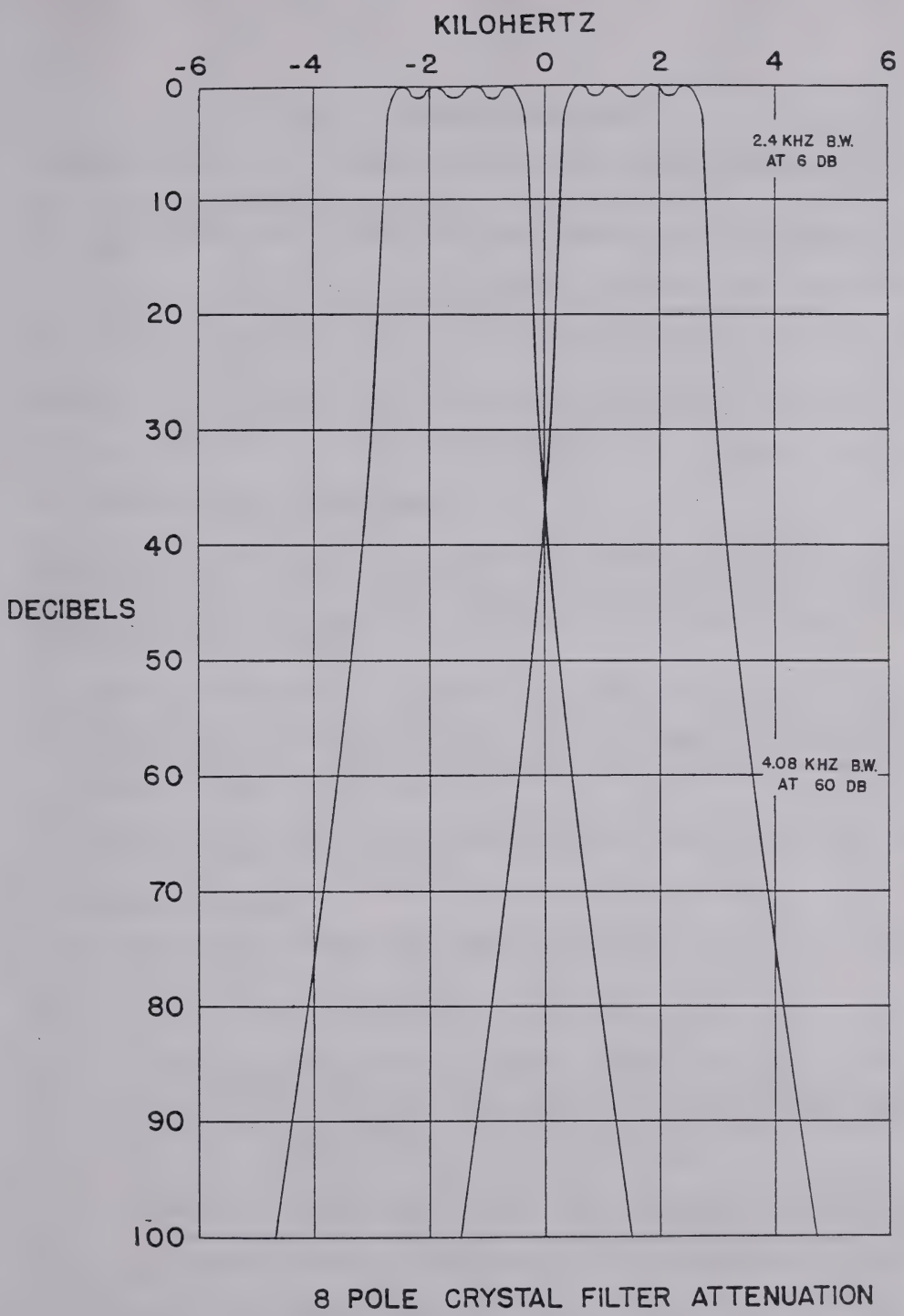


FIGURE 14 BOTTOM VIEW T-4XB



8 POLE CRYSTAL FILTER ATTENUATION

FIG. 15

VII. ALIGNMENT INSTRUCTIONS

Alignment of the T-4XB will require the following equipment:

1. An 11 megohm VTVM with RF probe.
2. A 52 ohm dummy load of sufficient power handling capacity (Heathkit Cantenna).
3. The T-4XB has a built-in RF output indicator which can be used. However, an external indicator would be much more convenient.
4. A 12.6 MHz crystal for R-4, R-4A, or R-4B and T-4XB if 1.8 - 3.0 MHz range is to be aligned.

WARNING: Do not attempt to operate the transmitter without connecting to a dummy load or serious damage may result.

A. ADJUSTMENT OF RF & MIXER STAGES

This procedure assumes that only a "touch-up" alignment is necessary. In the event that a unit is badly mis-aligned or if the following procedure does not give satisfactory results, a more elaborate procedure involving the use of a signal generator is necessary. This procedure can be obtained by writing the CUSTOMER SERVICE DEPARTMENT.

1. Set the RF TUNE knob to its clockwise stop. Measure the length of the slugs above the coil form on T-4, T-5, T-6 and T-7. The slugs should be exactly 9/16" out of the coil forms. (This is a factory adjustment and should be correct. Check the measurements carefully before altering the position of any of these slugs.)

2. Set the RF TUNE control to the counter-clockwise stop. Adjust the pointer to 0 by slipping it on the shaft.

3. 80 meter alignment -

   a. Adjust the RF TUNE control until the slugs are even with the tops of the coil forms.

   b. Set the transmitter frequency to 3.700 MHz.

   c. Tune and load the transmitter without moving the RF TUNE control. If the transmitter loads to over 200 ma plate current, reduce the plate current to 200 ma by turning down the GAIN control. If the transmitter is not badly mis-aligned, some increase in plate current should be noted. Any increase is enough to use for alignment.

   d. With the plate current at 200 ma or less, tune the two 3.5 MHz RF trimmers for maximum plate current. The RF trimmers are in the two columns nearest the rear of the chassis, along the left side. If the plate current exceeds 200 ma, reduce it by turning down the GAIN control.

   e. Detune T-5 by touching the rotor contact of S-4b (the second band switch wafer from the front) with a 6" screw driver with an INSULATED HANDLE and tune the front 3.5 MHz injection trimmer for maximum plate current.

f. Detune T-4 by touching the screw driver to the rotor contact of S-4 (the front band switch wafer) and tune the rear injection trimmers for maximum plate current. Always keep the plate current below 200 ma with the GAIN control.

WARNING:	The rotor of S-4a is connected to +250 volts! Use extreme caution.

4. For the different bands, repeat a, b, c, and d using the settings given below:

BAND	SLUG SETTINGS (By rotating RF TUNE)	VFO
7.0	3/16" above coil form	7.200 MHz
14.0	11/32" above coil form	14.200 MHz
21.0	7/16" above coil form	21.500 MHz
28.5	31/64" above coil form	28.900 MHz

5. On 160 meters, the RF TUNE control is adjusted such that the tops of the slugs are 3/32" below the tops of the coil forms. A 12.6 MHz crystal is needed in the T-4XB.

B. CARRIER OSCILLATOR, FILTER MATCH, & BALANCED MODULATOR

1. Follow the regular tune-up procedure on any ham band. Turn FUNCTION switch to SSB, rotate GAIN full CCW and depress push-to-talk switch or short push-to-talk line to ground at the mike jack.

2. Rotate CARRIER BALANCE control on top of chassis full CCW.

3. Switch SIDEBAND switch to upper sideband and adjust C2 for .1 amps of plate current. Tune T14, T2 and T3 for maximum plate current.

4. Depress and rotate the METER control full CW for maximum relative RF output sensitivity and adjust C2 so that when switching between upper and lower sideband, the relative outputs are equal or unreadable.

5. Rebalance carrier as described under "Tuning Procedure", Page 14, Paragraph C.

C. NEUTRALIZING FINAL AMPLIFIERS

1. Set BAND switch to 28.5 and MAIN TUNING dial to .800. Follow standard tune up procedure while loading into 52 ohm dummy load.

2. Depress output meter switch. Note meter reading and turn up meter sensitivity until meter reads well up scale. Then back off GAIN control until approximately 2/3 of maximum output is obtained.

3. Very carefully adjust plate control so that you are exactly on the dip in plate current. Depress output meter switch. Observe reading. Tune plate capacitor clockwise slightly to see if there is a rise in output. Return to exact plate current dip and again depress output meter and tune plate capacitor counter-clockwise slightly, looking for a rise in output meter indication.

4. If there was no rise in output in either direction, the transmitter is properly neutralized. If the output did rise on either side of the dip, the set needs neutralizing. Adjust C-49 in small steps repeating step 3 after each adjustment until maximum output and plate current dip exactly coincide. (The adjustment screw for C-49 is accessible in the power amplifier compartment beneath the chassis.

D. CRYSTAL OSCILLATOR CHECK

1. In order to tell whether or not the crystal oscillator is operative on a particular crystal in the T-4XB, first locate the 6HS6 premixer (V-8) and temporarily short the cathode (pin 7) to ground.

2. The measure the voltage on the grid (pin 1) with the DC probe of an 11 megohm VTVM through a 1 megohm series resistor on end of probe.

3. If the oscillator is operating properly a voltage of from -2 to -3 volts should be observed.

E. VFO ADJUSTMENT

The permeability tuned VFO was carefully adjusted at the factory and should require no further alignment. If it does not appear to track from one end of its range to the other, it should be returned to our plant for realignment. Maximum calibration error is 1 KHz when calibrated to the nearest 100 KHz point.

If you notice the same error from one end of the band to the other, any you cannot correct it with the movable dial index, the main dial may be slipped on its shaft enough to bring the corrector back into range.

IX. AC-4 POWER SUPPLY

The R. L. DRAKE COMPANY Model AC-4 is a complete power supply capable of supplying all of the required voltages for our TR-3 and TR-4 Transceivers as well as our T-4/T-4B and T-4X/T-4XB Transmitters with the proper filtering and regulation. The unit may be operated from 120 or 240 VAC, 50 or 60 Hertz.

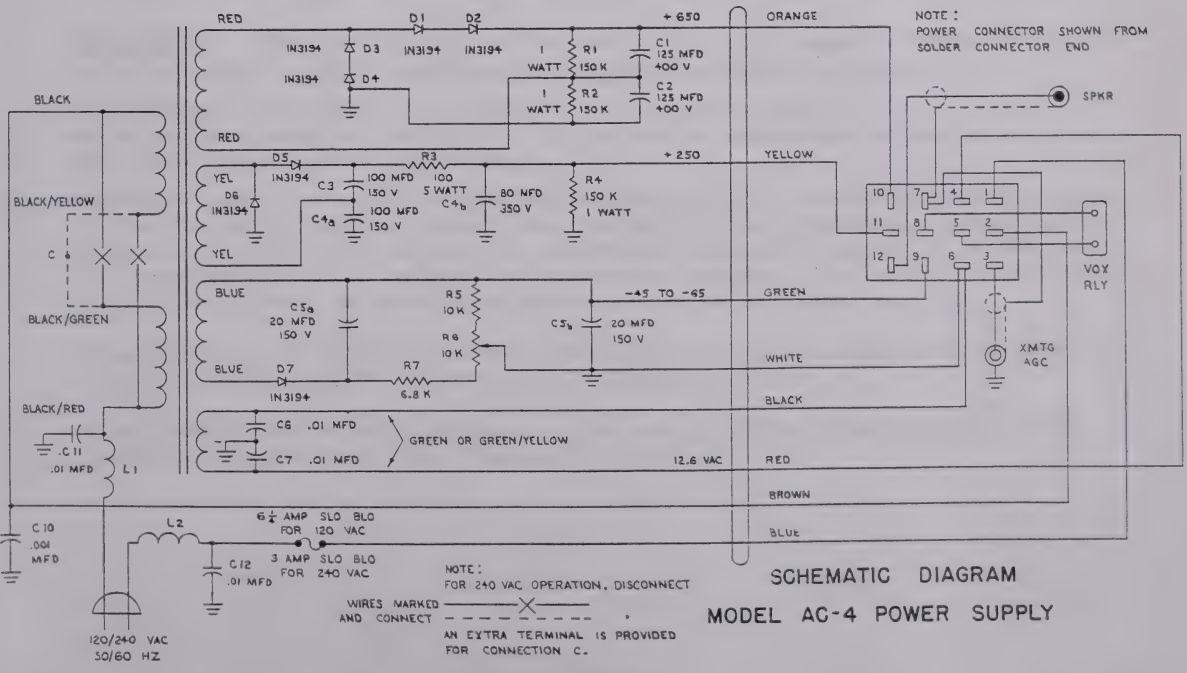
It is designed to fit into our MS-4 Matching Speaker or RV-4 Remote VFO to become a single unit.

To mount it in these units, slide it in from the rear so that the line cord and power cable face outward. Fasten it in place with the four studded rubber feet provided with the unit.

To connect, plug the female power connector on the end of the power cable into the male connector on the rear of the TR-3, TR-4, T-4/T-4B or T-4X/T-4XB. (See installation instructions for the appropriate equipment). A 6" lead terminated in a female phono plug extends from the power connector for connecting the MS-4 Speaker when the unit is used with our TR-3 or TR-4 Transceivers.

The bias adjustment should be set properly before any operation is attempted. (See tune up procedure).

IMPORTANT: Never ship the AC-4 mounted inside the Speaker or Remote VFO case or serious damage to the case will result.



SCHEMATIC DIAGRAM

MODEL AC-4 POWER SUPPLY

X. DC-4 POWER SUPPLY

GENERAL DESCRIPTION - The R. L. DRAKE Model DC-4 Power Supply is a self contained power converter which transforms 12 VDC to the voltage necessary to operate our TR-4, T-4XB or T-4B. A receptacle supplying 115 VAC permits operation of the R-4B/T-4XB or T-4B combination.

SPECIFICATIONS

INPUT:	12 VDC
OUTPUT:	650 VDC at 300 ma average (500 ma peak) 250 VDC at 175 ma -45 to -65 VDC adjustable bias into 33 K ohms 115 VAC at 600 ma for receiver operation *(115 VAC at 1.3 A if used alone)
FREQUENCY:	Approximately 330 Hertz square wave
SIZE:	8½" L x 4-1/4" W x 3½" H
WEIGHT:	7 pounds

* An On-Off switch to short Pins 1 and 2 of the S-312-CEE female connector should be used to provide 115 VAC output for applications other than an R-4B Receiver. A "tube saver" such as GC Electronics No. 25-898 may be required for loads other than an R-4B. This is due to the extremely low cold resistance of some loads such as incandescent lamps, some TV sets, etc.

INSTALLATION - The DC-4 is supplied for use in cars with negative ground system.

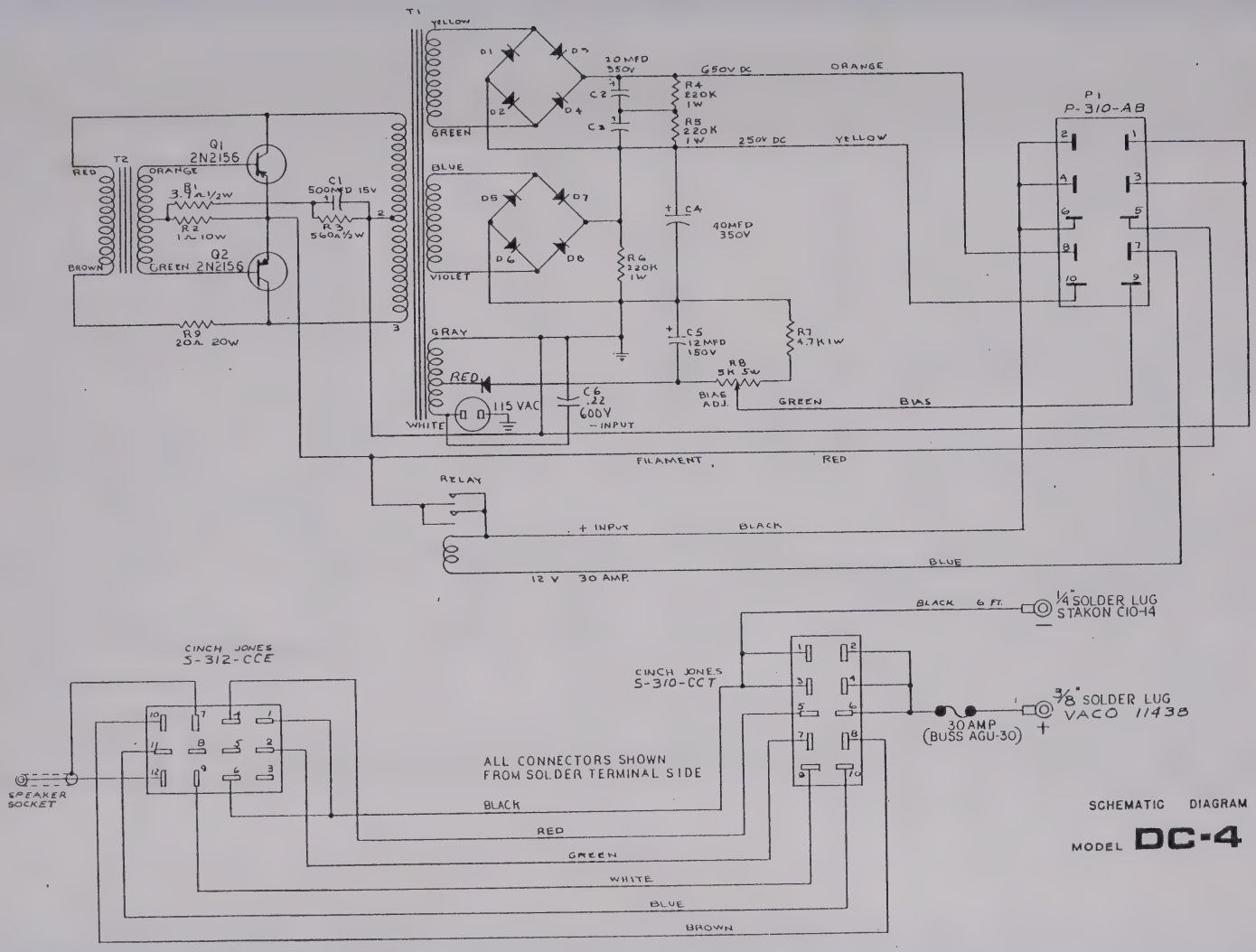
DO NOT USE WITH POSITIVE GROUND SYSTEMS OR SERIOUS DAMAGE MAY RESULT.

We recommend that the DC-4 be mounted on the passenger side of the fire wall. It should not be placed in the trunk or in the engine compartment unless it is protected from water and engine heat.

Attach the short black wire of the cable assembly to the nearest convenient ground and run the red/white wire through the fire wall to the ungrounded terminal of the battery, or to the "hot" terminal of the starter solenoid. Mount the fuse holder in a convenient location as near the battery as possible. Cut the black and red/white wires as short as possible to avoid unnecessary voltage drop.

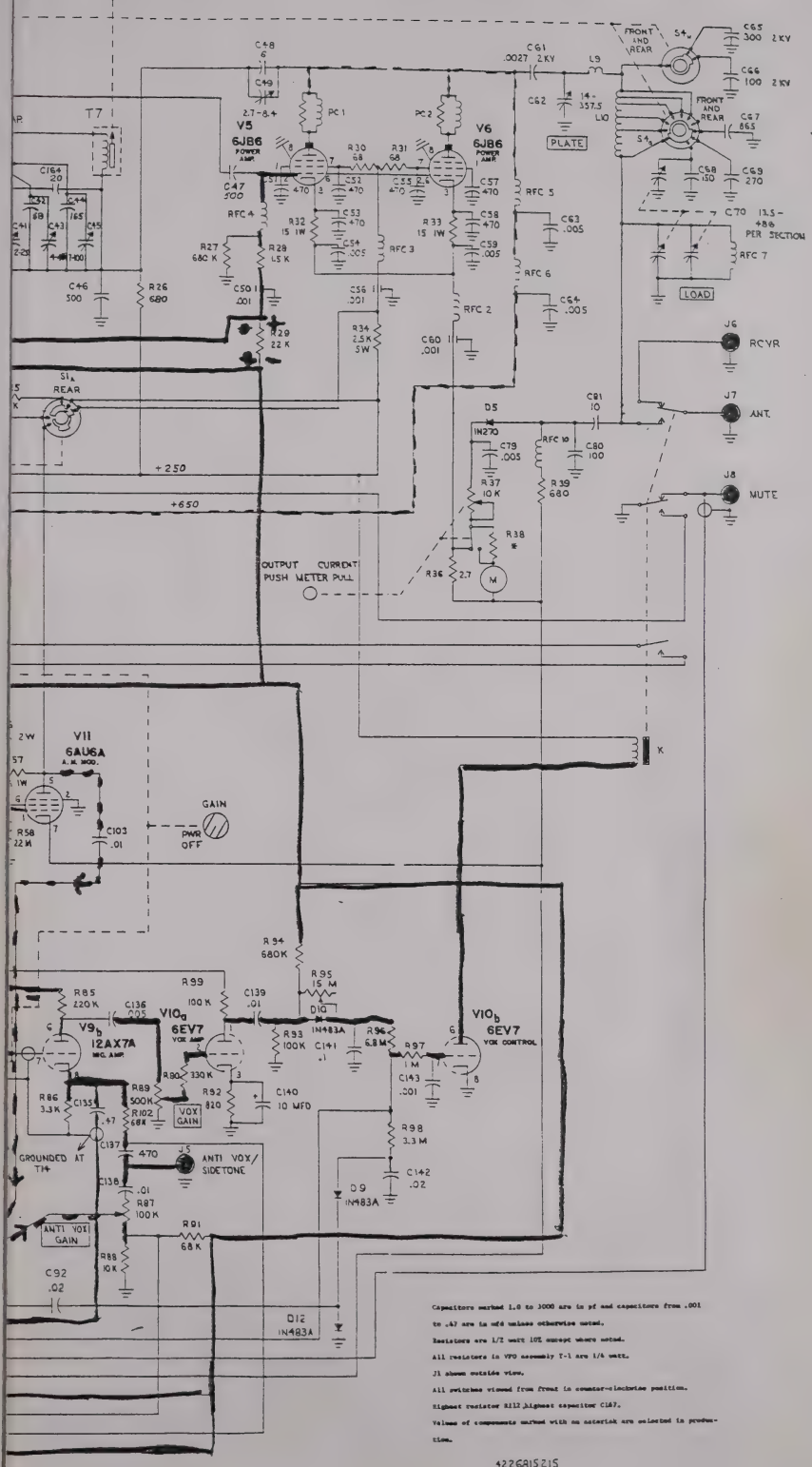
Connect the DC-4 Power Supply to the transmitter using the cable assembly supplied. Coil up any excess cable and tape it in a convenient place.

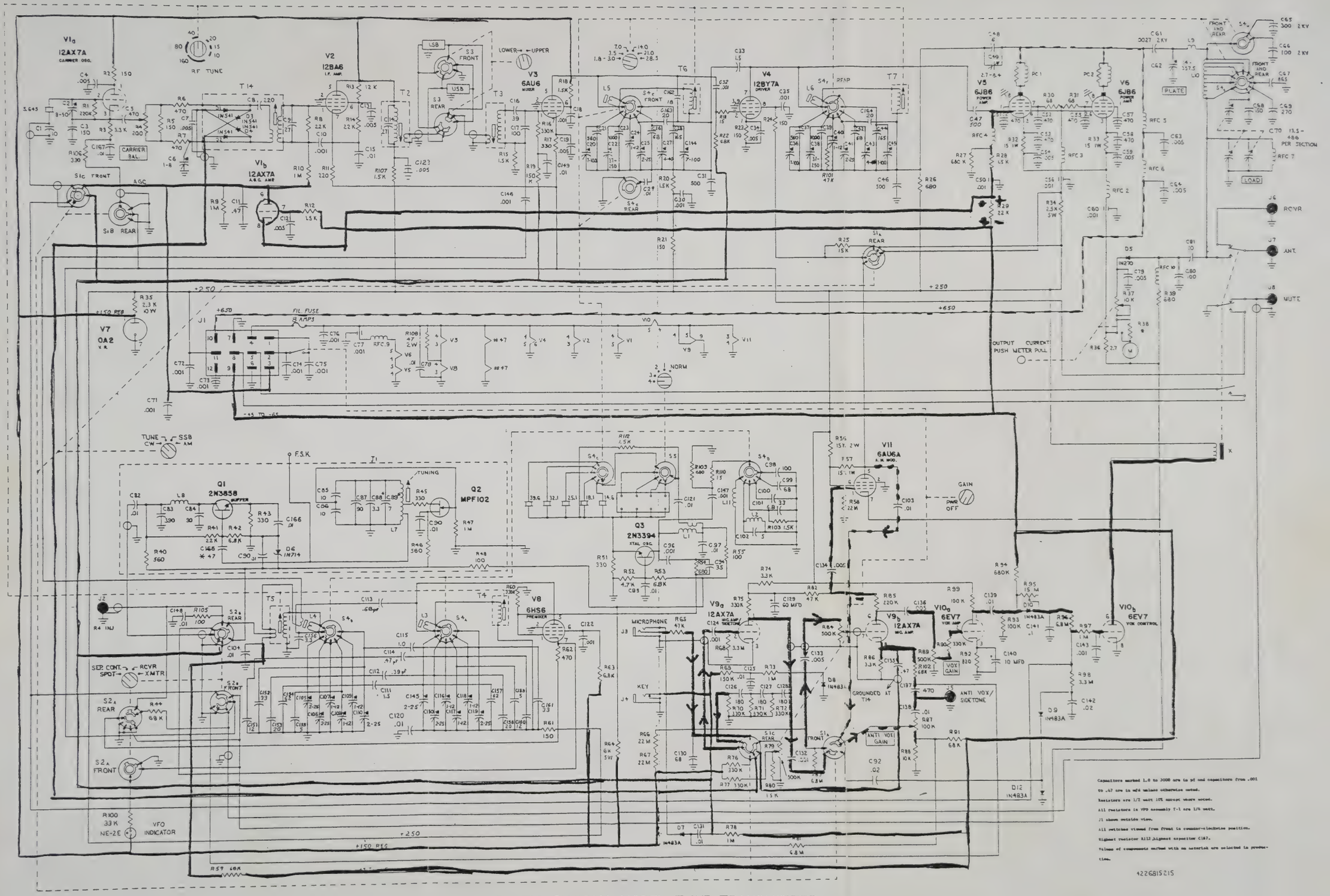
Adjust the BIAS ADJ control, located on the end of the unit, as described in the transmitter instructions under "Tuning Procedure".



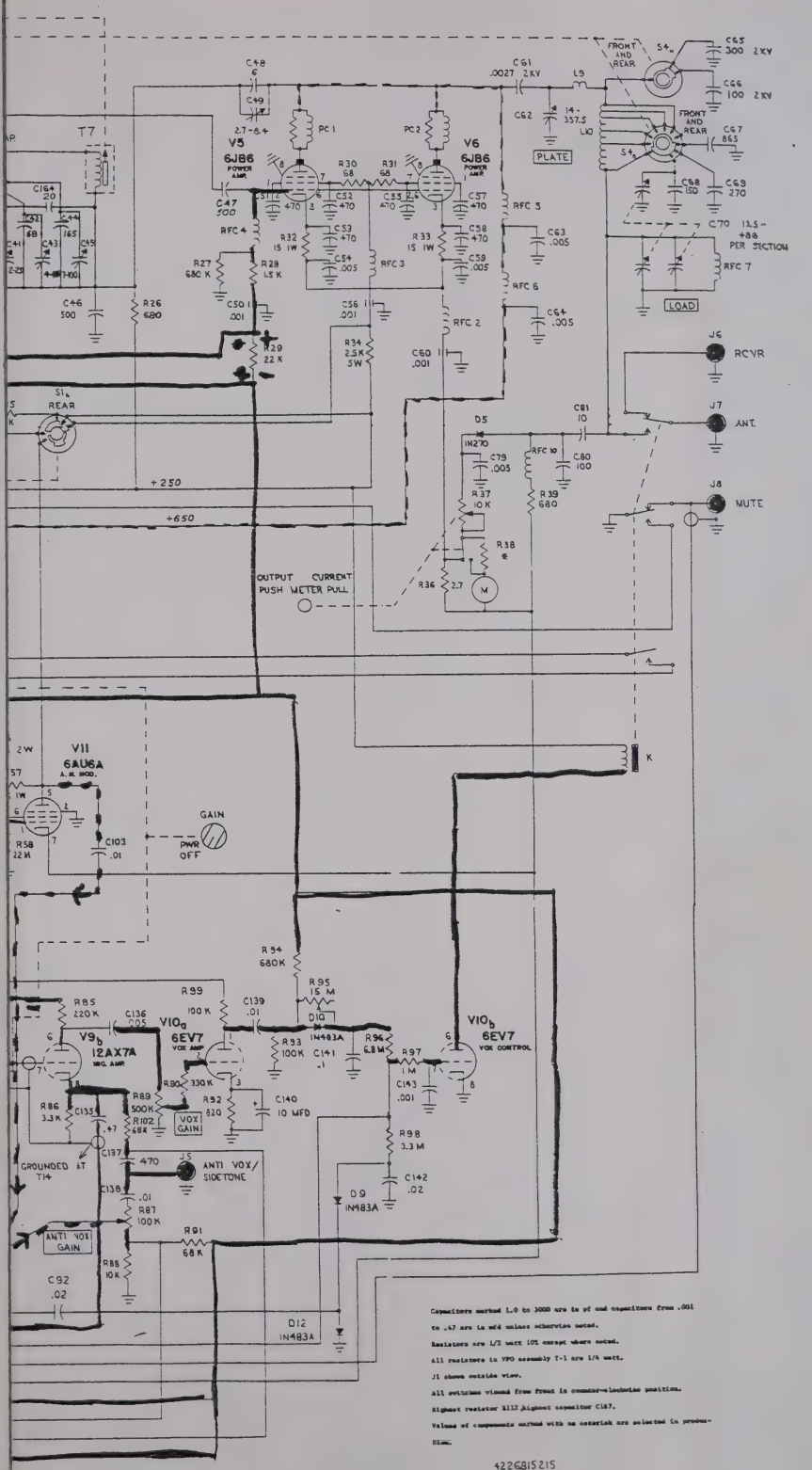
SCHEMATIC DIAGRAM

MODEL **DC-4**


V5 6JB6 POWER AMP.
V6 6JB6 POWER AMP.
V11 6AU8A A.M. MOD.
V9b 12AX7A MIC. AMP.
V10a 6EV7 VOX AMP.
V10b 6EV7 VOX CONTROL
FRONT AND REAR
PLATE
LOAD
PER SECTION
RCVR
ANT.
MUTE
GAIN
PWR OFF
VOX GAIN
ANTI VOX GAIN
ANTI VOX/ SIDETONE
GROUNDED AT T14
OUTPUT CURRENT PUSH METER PULL
+250
+650
D5 IN270
D9 IN483A
D10 IN483A
D12 IN483A
Capacitors marked 1.0 to 1000 are in pf and capacitors from .001 to .47 are in mfd unless otherwise noted.
Resistors are 1/2 watt 10% except where noted.
All resistors in VFO assembly T-1 are 1/4 watt.
J1 shown outside view.
All switches viewed from front in counter-clockwise position.
Highest resistor R112 highest capacitor C147.
Values of components marked with an asterisk are selected in production.
422G815Z15



SCHEMATIC DIAGRAM MODEL T-4XB TRANSMITTER



Capacitors marked 1.0 to 3000 are in pf and capacitors from .001 to .47 are in mfd unless otherwise noted.

Resistors are 1/2 watt 10% except where noted.

All resistors in VFO assembly T-1 are 1/4 watt.

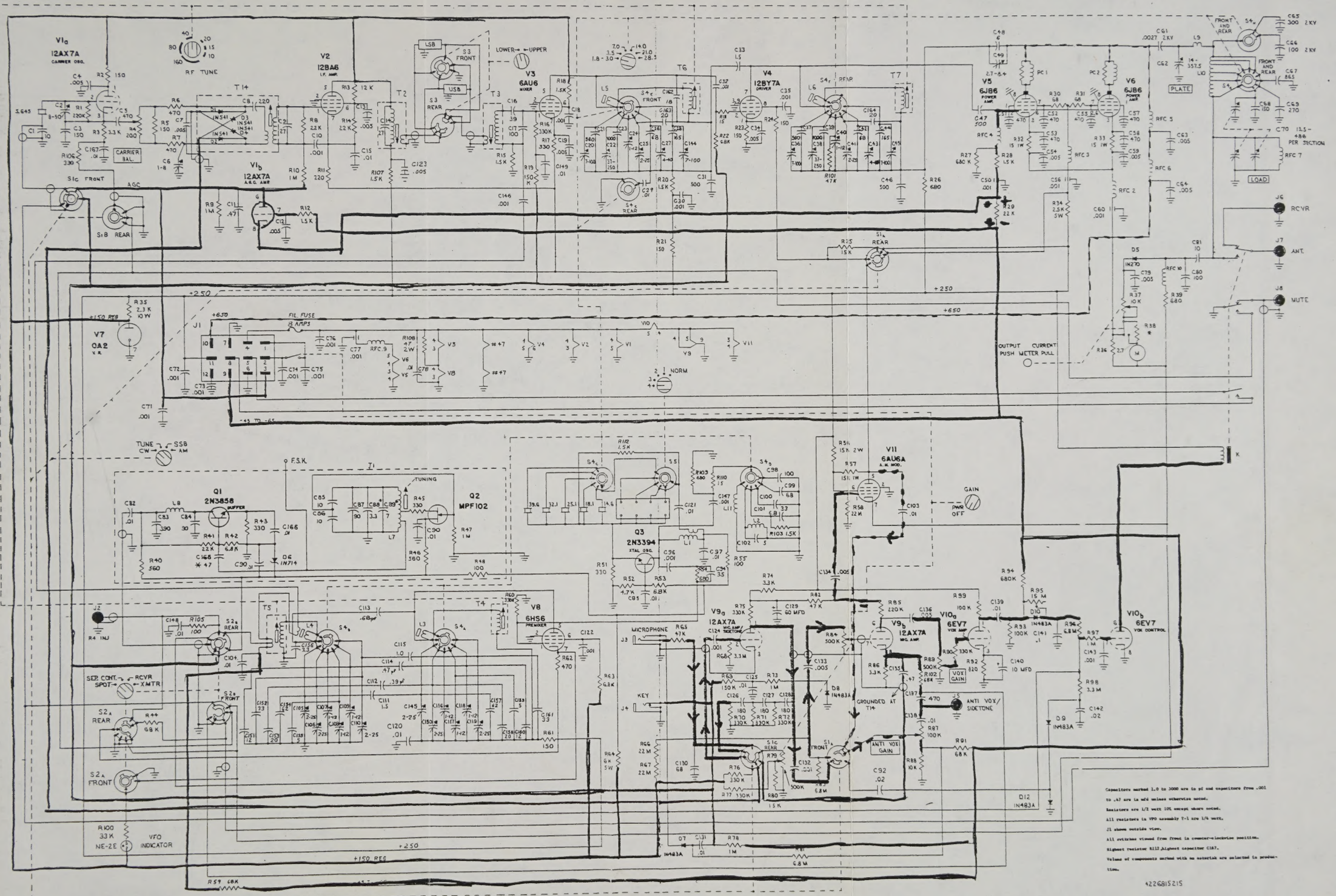
J1 shown outside view.

All switches viewed from front in counter-clockwise position.

Highest resistor R117 highest capacitor C187.

Values of components marked with an asterisk are selected in production.

422B815215



SCHEMATIC DIAGRAM MODEL T-4XB TRANSMITTER